

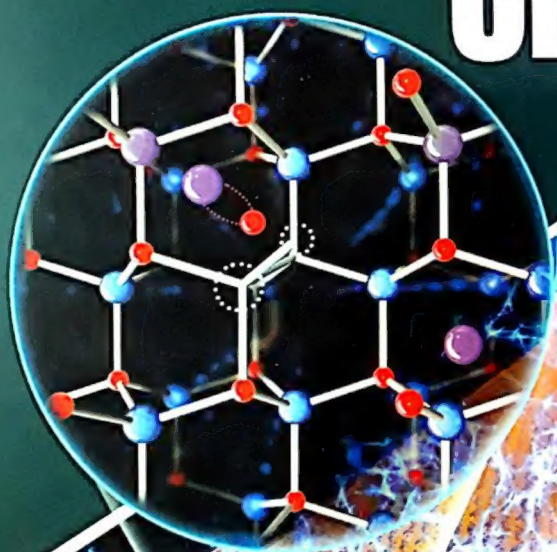
श्री  
**Balaji**

**M.S. Chouhan**

**Advanced Problems in**

# Organic Chemistry

for **JEE**



**11<sup>th</sup>**  
EDITION

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## About the Author



Mahendra Singh Chouhan (MSC Sir) is a renowned name in the realm of Organic Chemistry. Through a Chemical Engineer from Mumbai University, his great passion for the subject led him to impart guidance to IIT-JEE aspirants on a regular basis. His in depth knowledge and vast experience has helped innumerable students to achieve their dream of excelling at IIT, JEE and other such tough challenges.

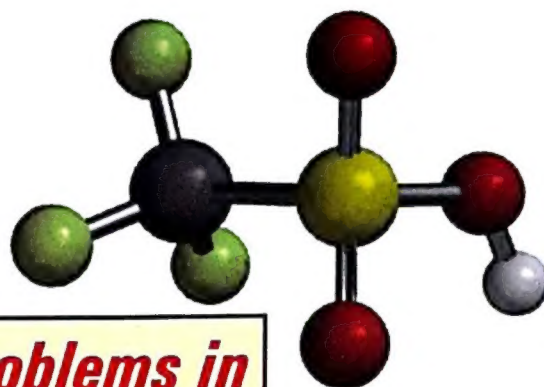
He has launched a website to extend the benefits of his expertise beyond the geographical barriers to all those who dare to dream and seek - [www.iitjeeorganic.com](http://www.iitjeeorganic.com).

The website provides expert guidance in all the areas of the subject in a most skillful manner. There are quizzes, challenging questions, notes, e-books and videos etc. This website is a complete guide in itself for organic chemistry and has been designed for IIT-JEE aspirants, keeping in mind the various syllabi and CBSE.

Highly recommended for the high flyers.



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**Balaji**



*Advanced Problems in*

# ORGANIC CHEMISTRY

for

**JEE**

by:

**M.S. Chouhan**

Director

Vibrant Academy, Kota



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# A few words to the JEE Aspirants

Dear JEE aspirants,

I hope that this collection of problems will surely help you during your preparation for JEE. In this book, each chapter consists of two levels :

**Level 1** - includes the problems having only one option correct. These problems are based on different facts and their twists.

**Level 2** - includes unique approach which may be used to solve the problems altogether different from the prevailing trend followed by JEE. These approaches will undoubtedly help you in the quick revision of the key facts and their applications.

I wish all of you a grand success in the ensuing Joint Entrance Examination. Your valuable suggestions and constructive criticism for the betterment of the book are welcome.

**M.S. Chouhan**



# Preface

It is a matter of great pleasure for me to present the eleventh edition of **"Advanced Problems in Organic Chemistry for JEE"** before JEE aspirants. During my teaching experience, I felt that the facts may be made more and more clear to the students through problematic approach. Although an ocean of material in Organic Chemistry is available with the students, yet the approach to design the problems has been changed in recent years and if one tries to swim in this ocean, it will be a very difficult task. To make the students more familiar with trends and tricks how to solve problems, the present problem book has been presented. In the current scenario of stiff competition especially for JEE, one must be clear that almost all the sincere applicants are well equipped with the facts of subject, yet the winner is one who knows how to use these equipments with accuracy and efficiency. As an experienced teacher, I would like to suggest students three golden rules to score high in Organic Chemistry:

1. Don't get behind
2. Work out a number of problems of different types
3. Revise through short notes / learning chart.

I hope that the present book will cater to the needs of JEE aspirants & as a matter of fact, they will enjoy the present venture and I would feel rewarded if this book is found helpful to the students and teachers in real terms. All attempts have been made to make the book error free however a few misprints may inadvertently creep.

I acknowledge the blessing and support of my mother Smt. Raj Kanwar, father Shri B.S. Chouhan, brother Dr. V.S. Chouhan, my wife and daughter. They inspired me all the time during the preparation of this book.

The support and valuable suggestions from my colleagues especially Mr. N. Avasthi, Mr. V. K. Jaiswal, Mr. Nitin Jain, Mr. N.K. Sethia, Mr. Vikash Gupta, Mr. Pankaj Joshi, Dr. S. Kothari, Mr. Vineet Khatri, Mr. Ashish Mishra, Mr. Manish Arora, Mr. Govind Khandelwal, Mr. Rahul Pareek, Mr. Rahul Malav, Mr. Divyesh Tiwari, Mr. Omkar Kelapure, Mr. Kishore Kilani, Mr. Mayank Pareek, Mr. Gurpreet Singh, Mr. Yogesh Jain, Madam Anjana Kamal, Mr. Aneet Choudhary, Mr. Shaliwahan Singh Rathore, Mr. Akshay Chaudhary, Mr. Hanuman Sahay, Mrs. Neha Joshi, Mrs. Neetu Jha, Mr. Kamlesh Gupta and Mr. Kumud Ranjan are highly acknowledged. I also pay my sincere thanks to all the esteemed members of **M/s Shri Balaji Publications** in bringing out this book in such a nice form.

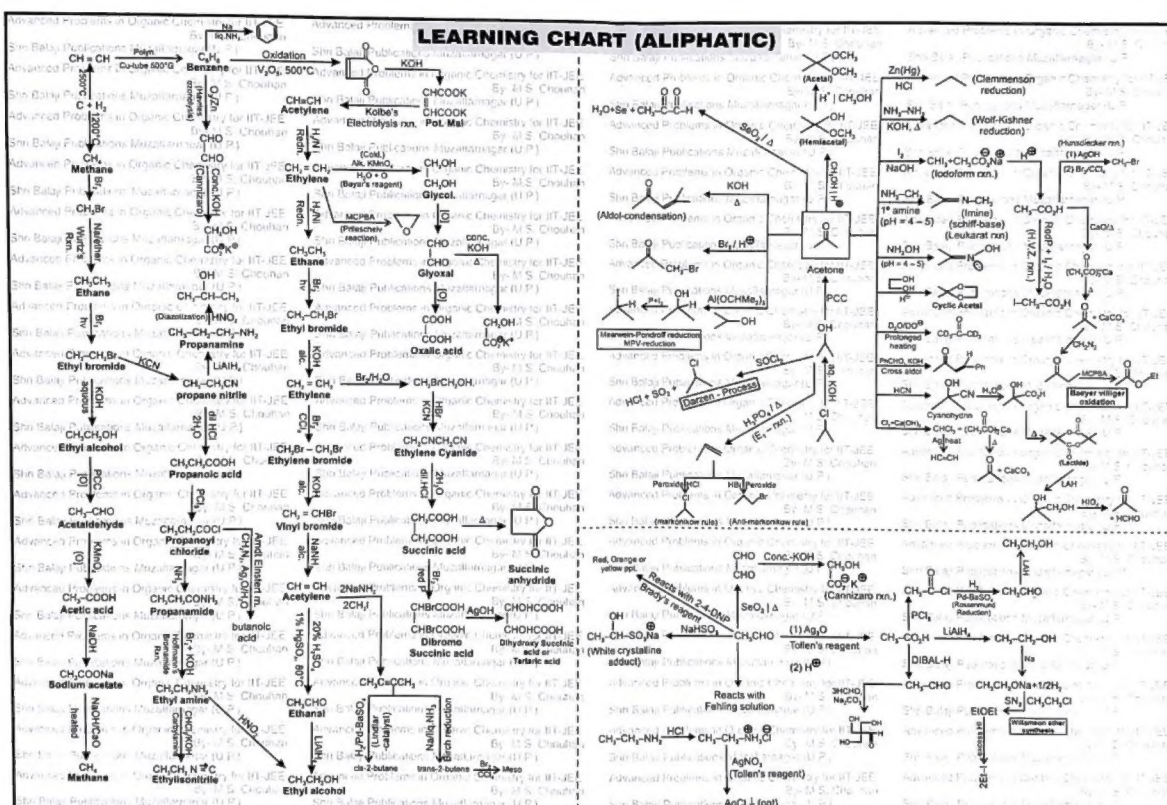
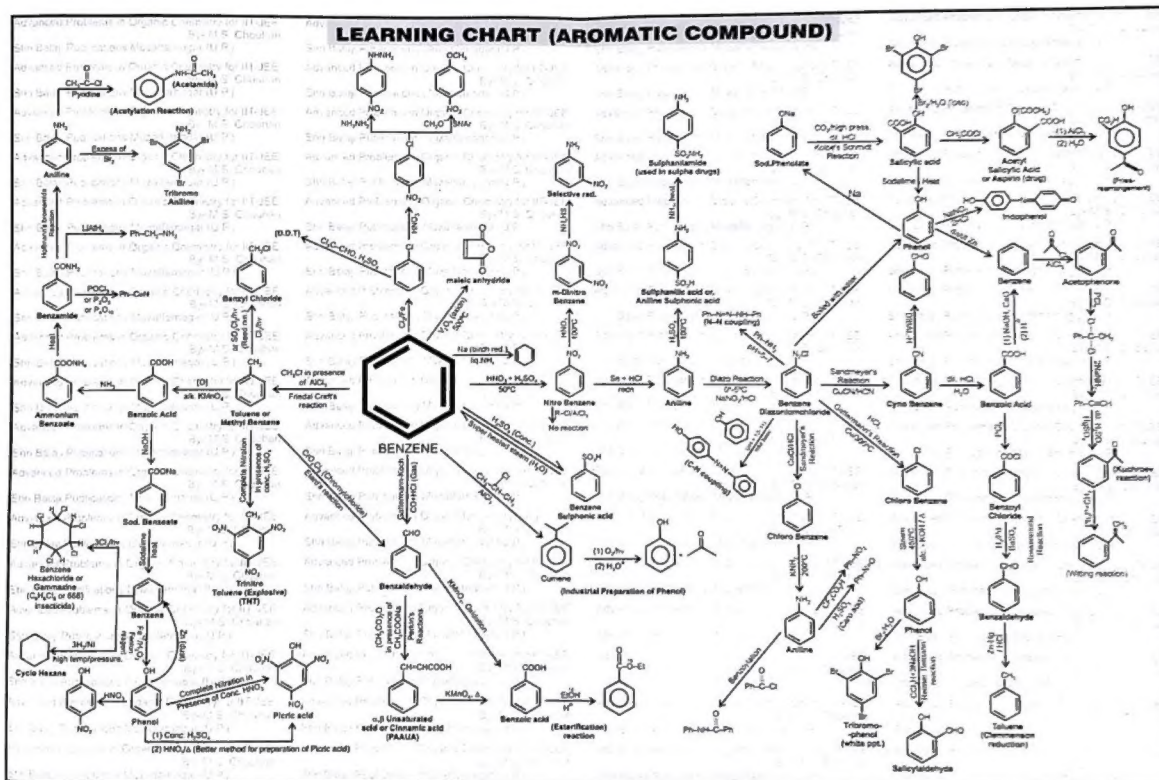
In the last, constructive criticism and valuable suggestions from the readers are most welcome to make the book more useful.

**M.S. CHOUHAN**

# Contents

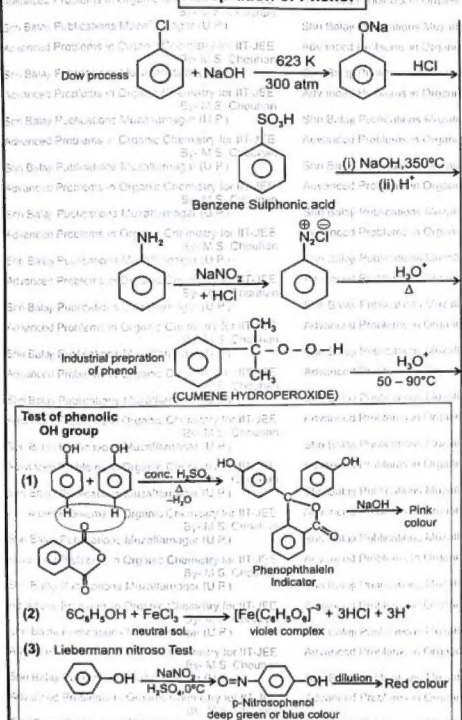
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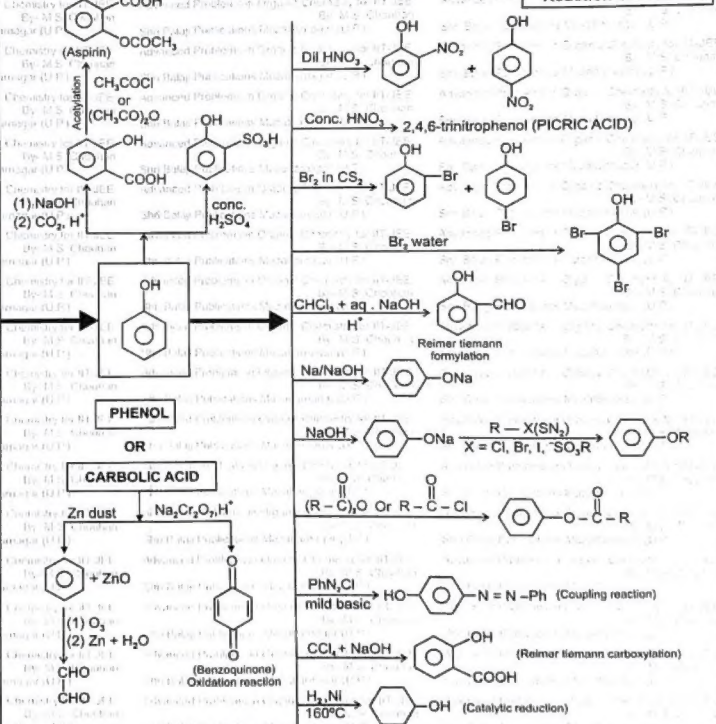


# LEARNING CHART OF PHENOL (A TO Z)

## Preparation of Phenol



## Reaction of Phenol



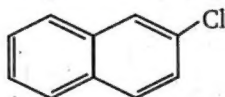


## 1

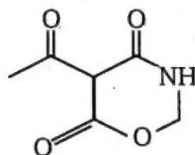
## GENERAL ORGANIC CHEMISTRY

## LEVEL-1

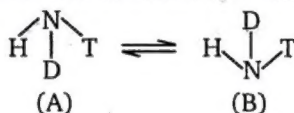
1. How many 2° Hydrogen atoms are present in the given following compound ?

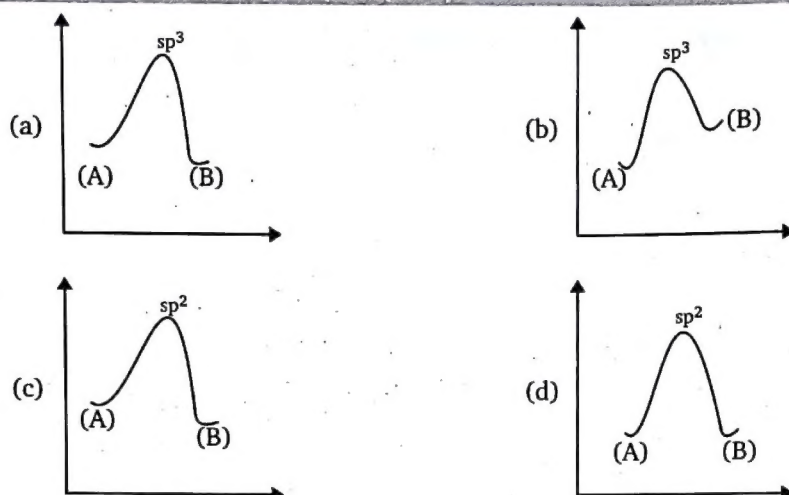


- (a) 2                      (b) 5                      (c) 7                      (d) 8
2. Identify which functional group is **Not** present in the given following compound ?

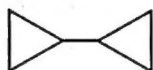


- (a) Ketone                      (b) Ester                      (c) Amide                      (d) Ether
3. Correct energy profile for amine inversion and hybridization of nitrogen in transition state is:





4.



(i)



(ii)

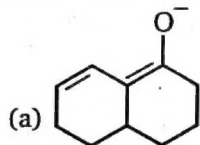


(iii)

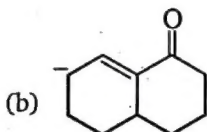
Correct order of the heats of combustion of above compounds is:

- (a) (i) > (ii) > (iii) (b) (i) > (iii) > (ii) (c) (ii) > (i) > (iii) (d) (ii) > (iii) > (i)

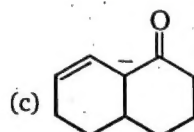
5. Which of the following is not a resonance structure of the others ?



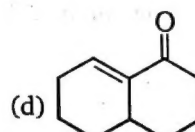
(a)



(b)

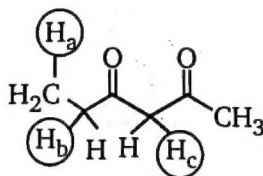


(c)

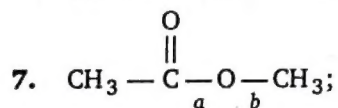


(d)

6. Rank the hydrogen atoms ( $H_a$ ,  $H_b$ ,  $H_c$ ) present in the following molecule in decreasing order of their acidic strength.



- (a)  $a > b > c$  (b)  $b > a > c$  (c)  $b > c > a$  (d)  $c > b > a$

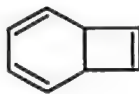


The correct relation between the bond lengths  $a$  and  $b$  is:

- (a)  $a = b$  (b)  $b > a$   
(c)  $b < a$  (d) Impossible to predict



8. The number of  $sp^2-sp^2$  sigma bonds in the compound given below is :



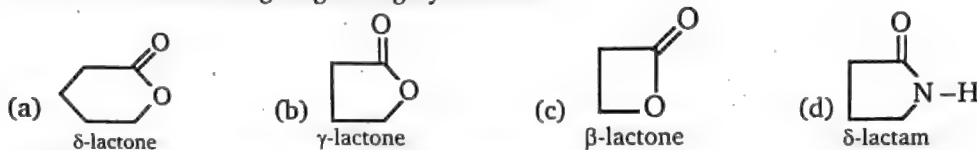
- (a) 1 (b) 3 (c) 4 (d) 5

9. The total number of lone pair of electrons in the given molecule is :

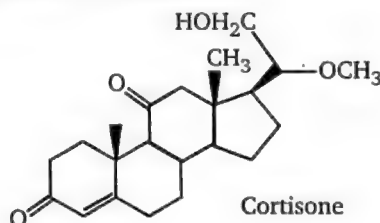


- (a) 2 (b) 3 (c) 4 (d) 5

10. Which of the following rings is highly strained ?

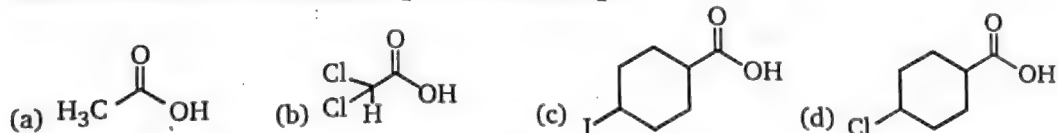


11. The functional groups present in Cortisone are :



- (a) ether, alkene, alcohol (b) alcohol, ketone, alkene, ether  
(c) alcohol, ketone, amine (d) ether, amine, ketone

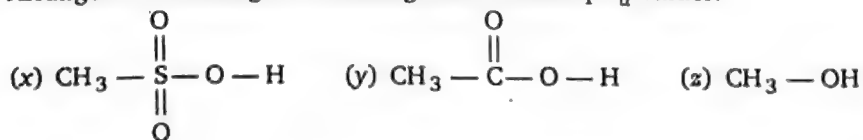
12. Select the acid with the highest  $K_a$  (i.e., lowest  $pK_a$ ).



13. Most stable carbocation among the following is :

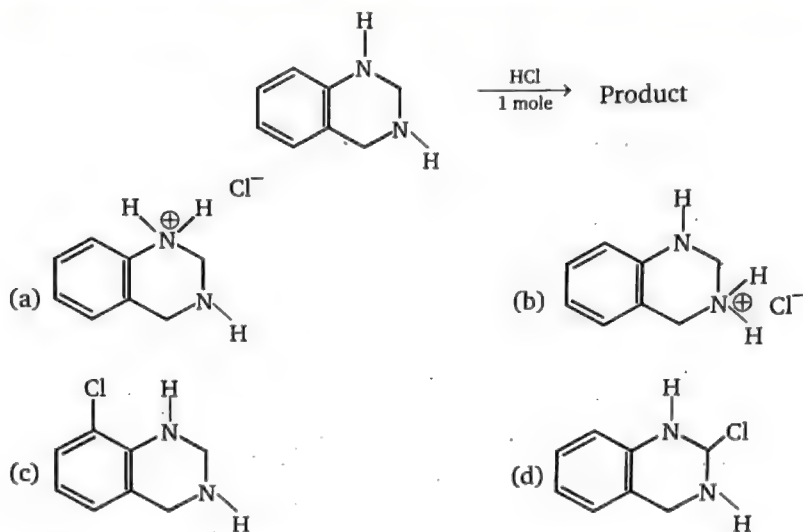


14. Arrange the following in increasing order of their  $pK_a$  values.

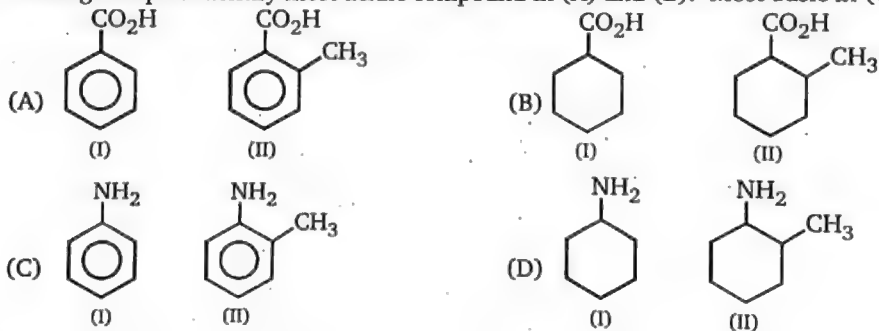


- (a)  $y < x < z$  (b)  $x < y < z$  (c)  $y < z < x$  (d)  $x < z < y$

15. Which is the major product of the following reaction ?



16. In the given pair identify most acidic compound in (A) and (B). Most basic in (C) and (D).



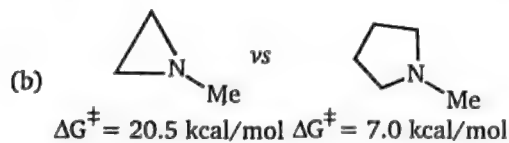
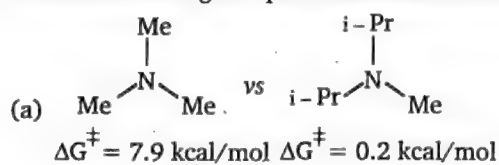
(a) A - I, B - II, C - I, D - II

(c) A - II, B - II, C - II, D - II

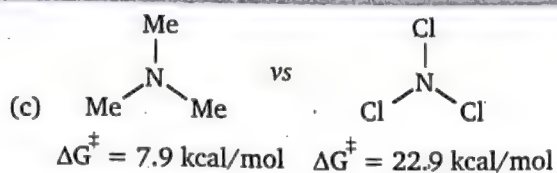
(b) A - II, B - I, C - I, D - II

(d) A - I, B - II, C - I, D - I

17. Several factors (steric, electronic, orbital interactions etc.) can affect the inversion barrier of an amine. In the given pair which data is correctly placed ?

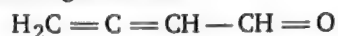






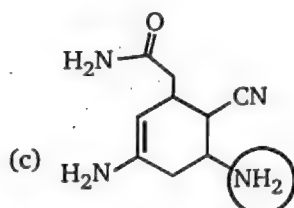
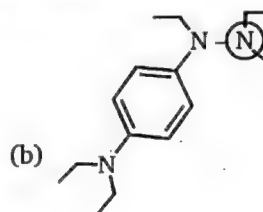
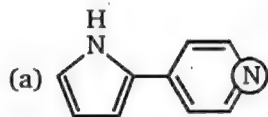
(d) All of these

18. Select the response that correctly identifies the number of carbon atoms of each type of hybridization in the compound given below



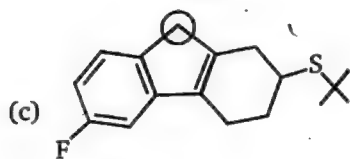
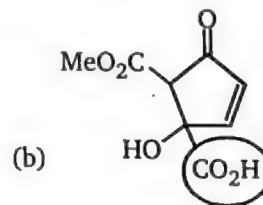
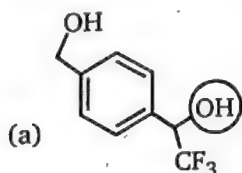
	$sp^3$	$sp^2$	$sp$		$sp^3$	$sp^2$	$sp$
(a)	2	2	0	(b)	1	3	0
(c)	0	3	1	(d)	1	2	1

19. Circle represents most basic atoms in these molecule. Which of the following is correct representation ?



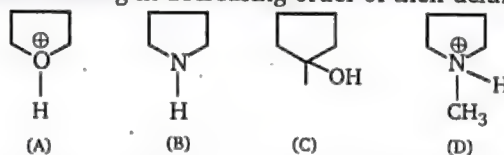
(d) All of these

20. Circle represent most acidic hydrogens in these molecules. Which of the following is correct representation ?



(d) All of these.

21. Arrange the following in decreasing order of their acidic strengths.



- (a)  $A > C > B > D$  (b)  $A > D > B > C$  (c)  $A > D > C > B$  (d)  $D > A > C > B$

- 22.



Cyclopropane

(I)



Cyclobutane

(II)



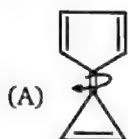
Cyclopentane

(III)

The correct order of heats of combustion of above compounds is :

- (a)  $I > II > III$  (b)  $II > I > III$   
(c)  $III > II > I$  (d)  $III > I > II$

- 23.



(B)



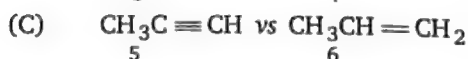
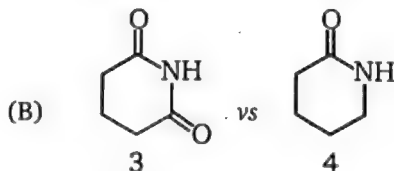
(C)



Compare carbon-carbon bond rotation across A, B, and C

- (a)  $A > B > C$  (b)  $A > C > B$   
(c)  $B > A > C$  (d)  $B > C > A$

24. Which of the following acids would have a STRONGER CONJUGATE BASE ?

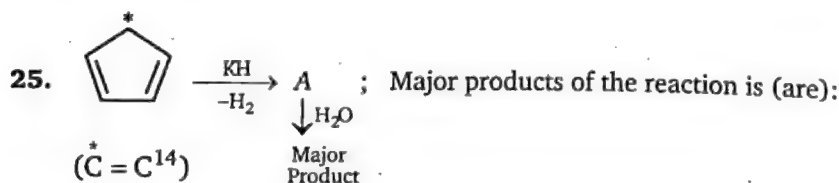





(a) 2, 4, 6

(b) 1, 3, 5

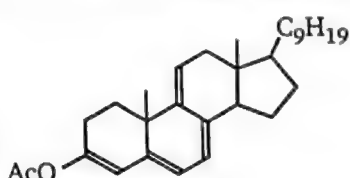
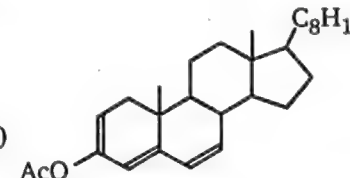
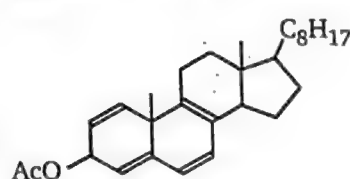
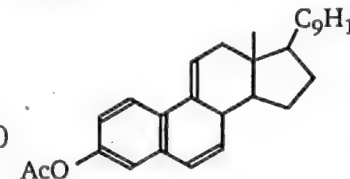
(c) 2, 3, 5

(d) 1, 3, 6

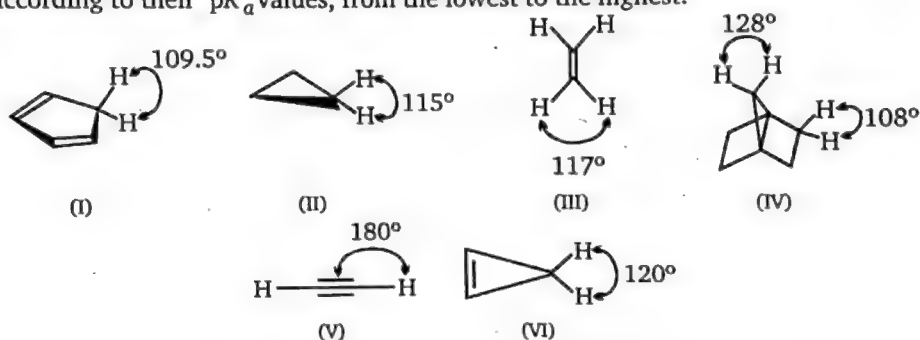


- (a)  (b)  (c)  (d) both (b) & (c)

26. Which of the following compound is most stable ?

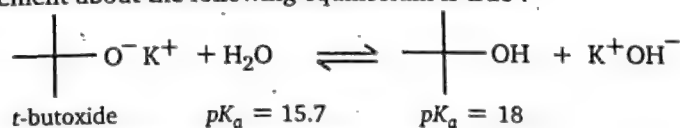
- (a)  (b)   
 (c)  (d) 

27. Selected bond angles for six hydrocarbons are shown below. Arrange these hydrocarbons according to their  $pK_a$  values, from the lowest to the highest.

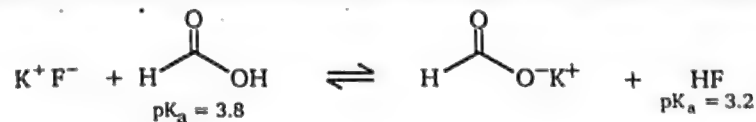


- (a)  $V < I < VI < II < III < IV$  (b)  $IV < I < II < III < V < VI$   
 (c)  $II < IV < I < VI < V < III$  (d)  $I < V < IV < III < II < VI$

28. Which statement about the following equilibrium is true ?



- (a) The equilibrium favours the products  
 (b) *t*-Butoxide is the dominant anionic species in the equilibrium  
 (c) Water is the weaker acid  
 (d) *t*-Butoxide is stabilized by resonance
29. Consider the following reaction involving two acids shown below : formic acid and HF.



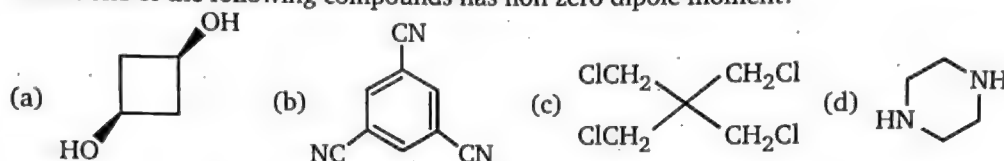


Which of the following statements about this reaction are true ?

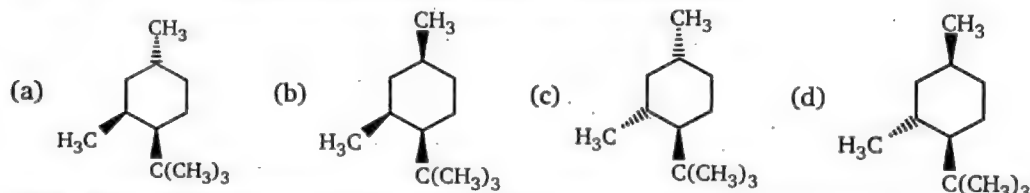
- (A) Formic acid is the strongest Bronsted acid in the reaction  
 (B) HF is the strongest Bronsted acid in the reaction  
 (C) KF is the strongest Bronsted base in the reaction  
 (D)  $\text{KO}_2\text{CH}$  is the strongest Bronsted base in the reaction  
 (E) The equilibrium favours the reactants  
 (F) The equilibrium favours the products  
 (G) Formic acid has a weaker conjugate base  
 (H) HF has a weaker conjugate base

(a) A, D and F      (b) B, D, and H      (c) A, C, and H      (d) B, D, E and H

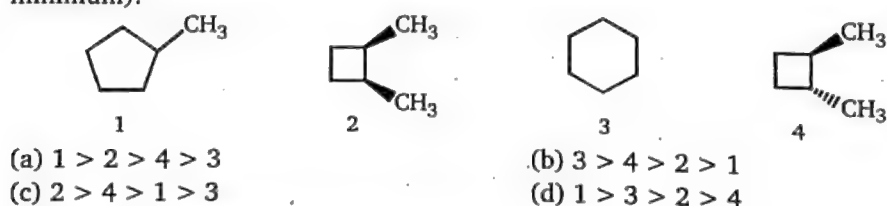
30. Which one of the following compounds has non zero dipole moment?



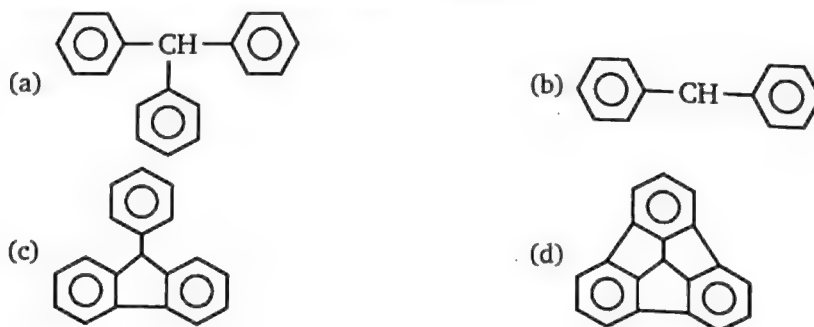
31. Which one of the following has the smallest heat of combustion ?



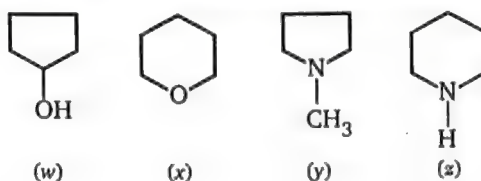
32. Rank the following substances in order of decreasing heat of combustion (maximum  $\rightarrow$  minimum).



33. Which of the following has lowest  $\text{pK}_a$  value ?

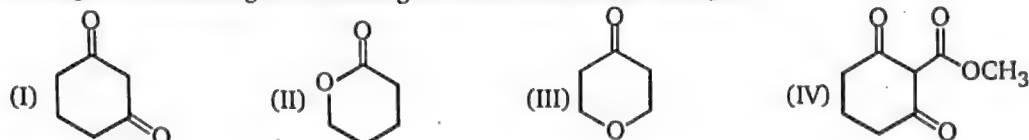


34. Arrange the following (w, x, y, z) in decreasing order of their boiling points:



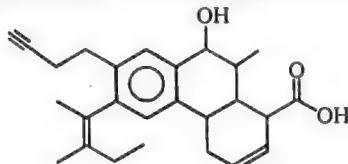
- (a)  $w > x > z > y$                       (b)  $w > x > y > z$   
 (c)  $w > z > y > x$                       (d)  $w > z > x > y$

35. Arrange the following in increasing order of their acidic strength.



- (a)  $\text{III} < \text{I} < \text{IV} < \text{II}$                       (b)  $\text{II} < \text{I} < \text{IV} < \text{III}$   
 (c)  $\text{I} < \text{III} < \text{IV} < \text{II}$                       (d)  $\text{II} < \text{III} < \text{I} < \text{IV}$

36. How many degrees of unsaturation are there the following compound ?

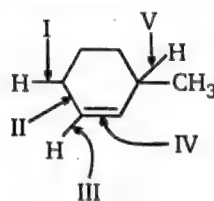


- (a) 6                      (b) 7                      (c) 10                      (d) 11
37. The heat of hydrogenation for 3-methylbutene and 2-pentene are  $-30$  kcal/mol and  $-28$  kcal/mol respectively. The heats of combustion of 2-methylbutane and pentane are  $-784$  kcal/mol and  $-782$  kcal/mol respectively. All the values are given under standard conditions. Taking into account that combustion of both alkanes give the same products, what is  $\Delta H$  (in kcal/mol) for the following reaction under same conditions ?

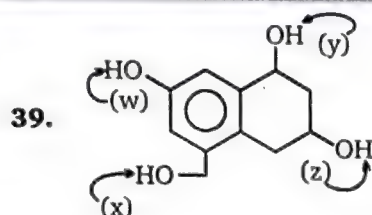


- (a) 0                      (b)  $-4$                       (c)  $-2$                       (d) 2

38. Which of the following  $\sigma$ -bonds participate in hyperconjugation ?



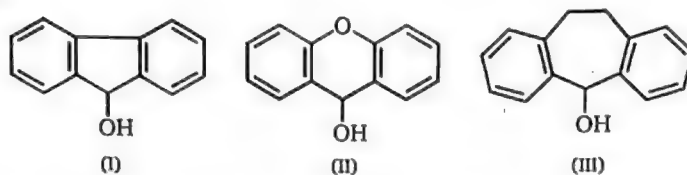
- (a) I and II                      (b) I and V                      (c) II and V                      (d) III and IV



Decreasing order of acidic strength of different (–OH) groups is :

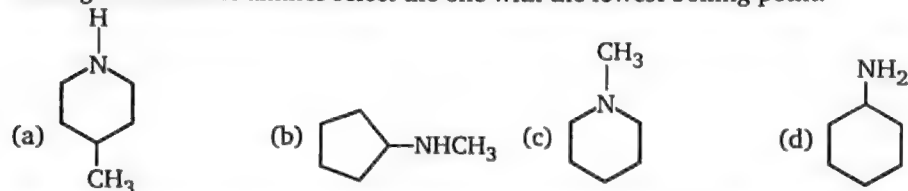
- (a)  $w > x > y > z$  (b)  $w > z > x > y$  (c)  $z > w > x > y$  (d)  $z > x > w > y$

40. Arrange the following alcohols in decreasing order of the ease of ionization under acidic conditions.

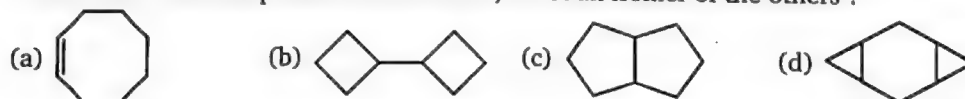


- (a)  $I > III > II$  (b)  $I > II > III$  (c)  $II > III > I$  (d)  $II > I > III$

41. Among the isomeric amines select the one with the lowest boiling point.



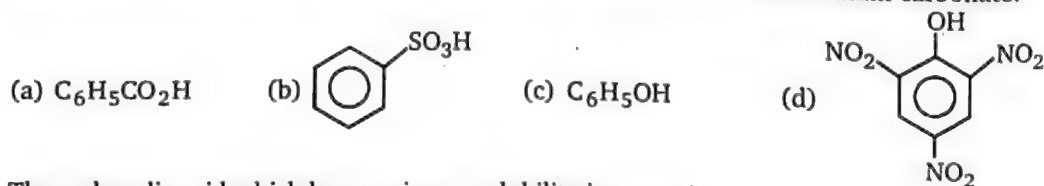
42. Which one of the compounds shown below, is not an isomer of the others ?



43. Arrange the anions (p)  $\text{CH}_3^-$ , (q)  $\text{NH}_2^-$ , (r)  $\text{OH}^-$ , (s)  $\text{F}^-$ , in decreasing order of their basic strength.

- (a)  $p > q > r > s$  (b)  $q > p > r > s$  (c)  $r > q > p > s$  (d)  $r > p > q > s$

44. One among the following compounds will not give effervescence with sodium carbonate:

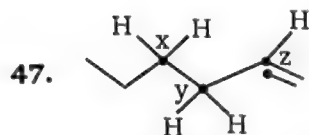
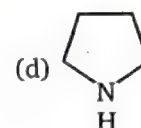
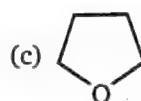
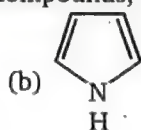
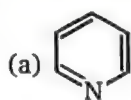


45. The carboxylic acid which has maximum solubility in water is:

- (a) phthalic acid (b) succinic acid  
(c) malonic acid (d) salicylic acid

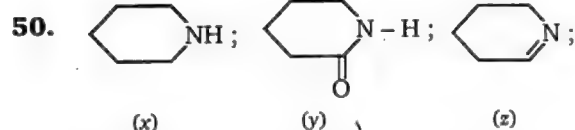
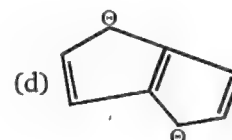
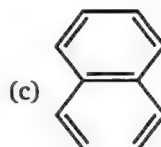
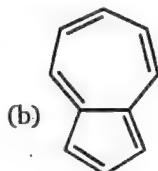
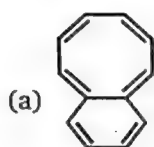


46. Among the following compounds, the most basic compound is :



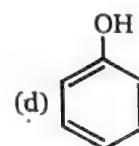
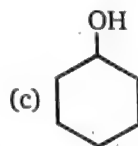
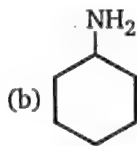
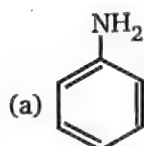
Arrange the (C-H) bonds x, y and z in decreasing order of their bond dissociation energies in homolysis.

- (a)  $y > x > z$       (b)  $z > x > y$       (c)  $z > y > x$       (d)  $y > z > x$
48. 23 g of sodium will react with methyl alcohol to give :
- (a) one mole of oxygen      (b)  $22.4 \text{ dm}^3$  of hydrogen gas at NTP  
(c) 1 mole of  $\text{H}_2$       (d) 11.2 L of hydrogen gas at NTP
49. Which of the following is most polar?

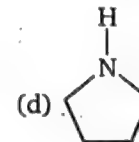
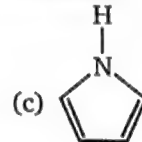
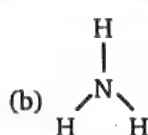
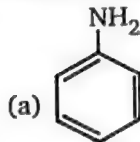


The correct order of decreasing basic strengths of x, y and z is :

- (a)  $x > y > z$       (b)  $x > z > y$       (c)  $y > x > z$       (d)  $y > z > x$
51. Which of the following is the strongest Bronsted acid ?



52. Which of the following is the strongest Bronsted base ?



53. Which of the following is polar aprotic solvent ?

(a) DMSO

(b) Crown ether

(c) DMG

(d) All of these

54. Some pairs of acids are given below. Select the pair in which second acid is stronger than first

- (a)  $\text{CH}_3\text{CO}_2\text{H}$  and  $\text{CH}_2\text{FCO}_2\text{H}$   
 (b)  $\text{CH}_2\text{FCO}_2\text{H}$  and  $\text{CH}_2\text{ClCO}_2\text{H}$   
 (c)  $\text{CH}_2\text{ClCO}_2\text{H}$  and  $\text{CH}_2\text{BrCO}_2\text{H}$   
 (d)  $\text{CH}_3\text{CH}_2\text{CHFCO}_2\text{H}$  and  $\text{CH}_3\text{CHFCH}_2\text{CO}_2\text{H}$


55.  $\text{H}-\text{C} \equiv \text{C} \overset{a}{-} \text{C} \equiv \text{C} \overset{b}{-} \text{CH}_3$ ;

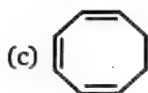
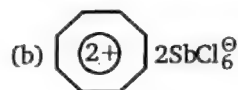
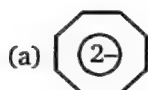
Compare the bond lengths  $a$  and  $b$ :

- (a)  $a = b$  (b)  $a > b$  (c)  $b > a$  (d)  $a \gg b$

56. Which (isomeric) amine has lowest boiling point ?

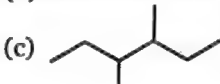
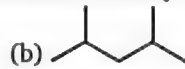
- (a)  $1^\circ$  amine (b)  $2^\circ$  amine  
 (c)  $3^\circ$  amine (d) cannot predict

57.   $\xrightarrow{2\text{SbCl}_5}$  P ; P will be :



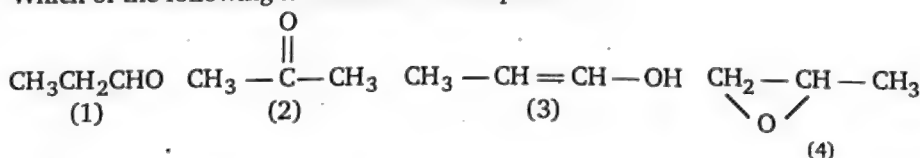
(d) mixture of (a) and (b)

58. Which of the following substances is not an isomer of 3-ethyl 2-methyl pentane ?



(d) All are isomers

59. Which of the following is an isomer of compound 1 ?

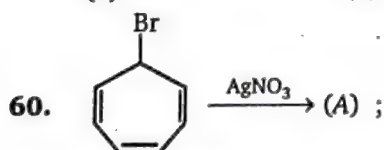


(a) 2

(b) 4

(c) 2 and 3

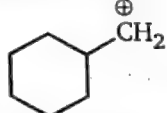
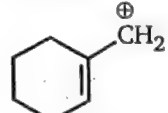
(d) all are isomers



Which statement is incorrect in respect of the above reaction ?

- (a) Product is aromatic (b) Product has high dipole moment  
 (c) Product has less resonance energy (d) Product is soluble in polar solvent

61. Some pairs of ions are given below. In which pair, first ion is more stable than second?

- (a)  $\text{CH}_3 - \overset{\oplus}{\text{C}}\text{H} - \text{CH}_3$  and  $\text{CH}_3 - \overset{\oplus}{\text{C}}\text{H} - \text{OCH}_3$   
 (b)  $\text{CH}_3 - \text{CH}_2 - \overset{\oplus}{\text{C}}\text{H} - \text{CH}_3$  and  $\text{CH}_2 = \text{CH} - \text{CH}_2 - \overset{\oplus}{\text{C}}\text{H}_2$   
 (c)  and   
 (d)  $\text{CH}_3 - \underset{\text{CH}_2 - \overset{\oplus}{\text{C}} - \text{CH}_3}{\underset{|}{\text{CH}}} - \text{CH}_3$  and  $\text{CH}_3 - \underset{\text{CH}_3 - \overset{\oplus}{\text{C}} - \text{CH}_3}{\underset{|}{\text{N}}} - \text{CH}_3$

62. Among the given pairs in which pair, first compound has higher boiling point than second?

- (a)  $\text{CH}_3 - \text{CH}_2\text{OCH}_3$  and  $\text{CH}_3 - \underset{\text{OH}}{\underset{|}{\text{CH}}} - \text{CH}_3$   
 (b)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$  and  $\text{CH}_3 - \text{CH}_2 - \underset{\text{CH}_2 - \text{CH}_3}{\underset{|}{\text{CH}}} - \text{CH}_3$   
 (c)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$  and  $\text{CH}_3 - \underset{\text{CH}_2 - \text{OH}}{\underset{|}{\text{CH}}} - \text{CH}_2 - \text{OH}$   
 (d)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$  and  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{Cl}$

63. Which of the following alcohols is the least soluble in water?

- (a) Ethanol (b) 1-Propanol  
 (c) 1-Butanol (d) 1-Pentanol

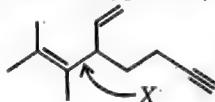
64. Which of the following alcohols is expected to have a lowest  $\text{pK}_a$  value?

- (a) Ethanol (b) 1-propanol  
 (c) 2, 2, 2-trifluoroethanol (d) 2-chloroethanol

65. Which of the following alkenes is the most stable?

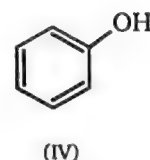
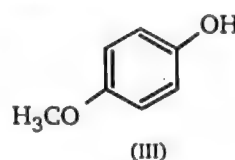
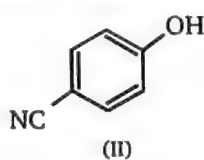
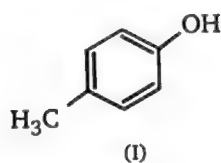
- (a)  (b)  (c)  (d) 

66. Bond X is made by the overlap of which type of hybridized orbitals?







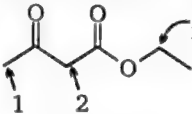



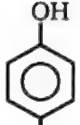
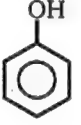
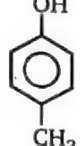
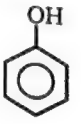


- (a)  $sp$  and  $sp^3$  (b)  $sp$  and  $sp^2$   
 (c)  $sp^2$  and  $sp^3$  (d) none of these

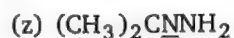
67. Increasing order of acidic strength of given compounds is :





- (a) III < I < IV < II  
(c) I < III < IV < II
- (b) II < I < IV < III  
(d) I < III < II < IV
68. -COOH + NaHCO<sub>3</sub><sup>\*</sup> → CO<sub>2</sub> + -COONa, C<sup>\*</sup> is with the product :  
(a) CO<sub>2</sub> (b) -COONa (c) both (d) none of these
69. Rank in the order of increasing acidity.  
(I) -OH (II) -NH<sub>2</sub> (III) -OH  
(a) III < I < II (b) I < III < II  
(c) III < II < I (d) II < I < III
70. Which compound has the highest value of pK<sub>a</sub>?  
(a) Cl-CH<sub>2</sub>-CH<sub>2</sub>-COOH (b) CH<sub>3</sub>-CH<sub>2</sub>-COOH  
(c) CH<sub>3</sub>-CH(Cl)-COOH (d) CH<sub>3</sub>-C(Cl)<sub>2</sub>-COOH
71. Consider the hydrogen atoms attached to three different carbon atoms (labeled 1, 2 & 3). Rank the attached hydrogen atoms in order from most acidic to least acidic.  
  
(a) 2 > 1 > 3 (b) 1 > 2 > 3 (c) 2 > 3 > 1 (d) 3 > 2 > 1
72. Decreasing order of acidic strengths of following compounds is :  
(x)  (y)  (z)   
(a) x > y > z (b) y > x > z (c) z > y > x (d) z > x > y
73. Among the given pairs, in which pair second compound is more acidic than first ?  
(a) BrCH<sub>2</sub>NO<sub>2</sub> and CH<sub>3</sub>CH<sub>3</sub>  
(b) CH<sub>3</sub>-C(=O)CH<sub>2</sub>CN and CH<sub>3</sub>-C(=O)CH<sub>3</sub>  
(c)  &   
(d)  & 

74. Which of the underlined atoms in the molecules shown below have  $sp$ -hybridization ?



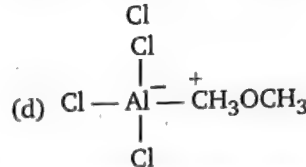
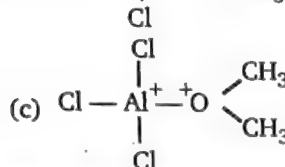
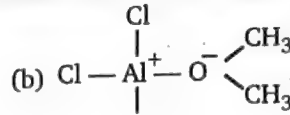
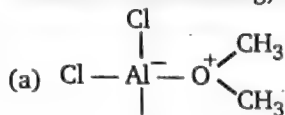
(a) x and z

(b) x, y, and z

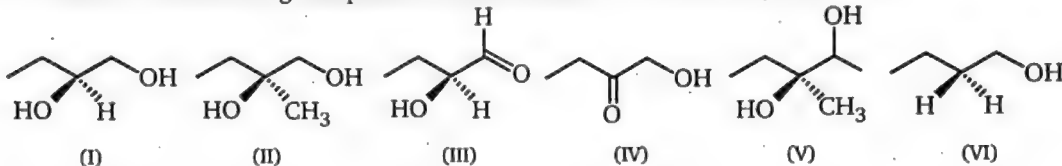
(c) u, w and x

(d) v, x and y

75. Which of the following, is the product of the reaction between  $\text{AlCl}_3$  and  $\text{CH}_3\text{OCH}_3$  ?



76. Which of the following compounds contain at least one secondary alcohol ?



(i)

(ii)

(iii)

(iv)

(v)

(vi)

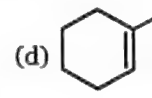
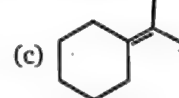
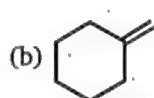
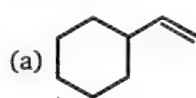
(a) I, II, IV, VI

(b) I, III

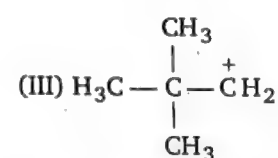
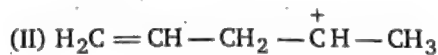
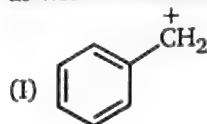
(c) I, II, III, V

(d) I, III, V

77. Which of the following has the most negative heat of hydrogenation ?



78. Which of the following options is the correct order of relative stabilities of cations I, II and III as written below (most stable first) ?



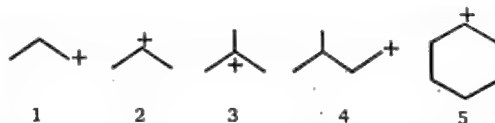
(a) I > II > III

(b) II > III > I

(c) III > I > II

(d) I > III > II

79. What is the decreasing order of stability (most stable  $\rightarrow$  least stable) of the following carbocations ?

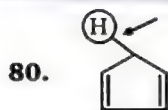


(a) 3 > 2 > 1 > 4 > 5

(b) 3 > 2 > 5 > 4 > 1

(c) 1  $\approx$  4 > 2  $\approx$  5 > 3

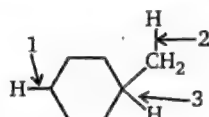
(d) 3 > 1  $\approx$  4 > 2  $\approx$  5



the hydrogen indicated by arrow will be easily removed as :

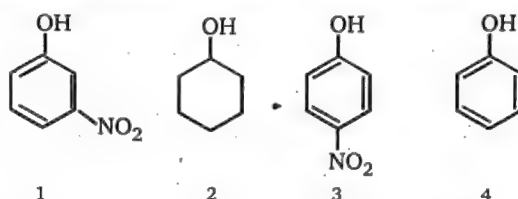
- (a)  $H^+$  (b)  $H^\ominus$  (c)  $H^\bullet$  (d)  $H^{-2}$

81. Rank the bond dissociation energies of the bonds indicated with the arrows. (from smallest to largest).



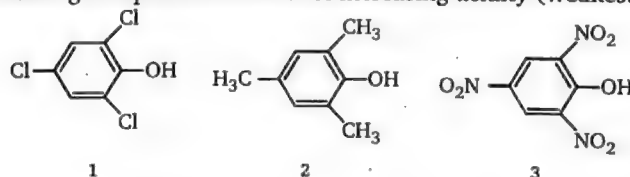
- (a)  $1 < 2 < 3$  (b)  $3 < 2 < 1$  (c)  $2 < 3 < 1$  (d)  $3 < 1 < 2$

82. Rank the following compounds in order of decreasing acid strength (most acidic  $\rightarrow$  least acidic).



- (a)  $2 > 4 > 1 > 3$  (b)  $1 > 3 > 4 > 2$  (c)  $3 > 1 > 2 > 4$  (d)  $3 > 1 > 4 > 2$

83. Rank the following compounds in order of increasing acidity (weakest acid first).

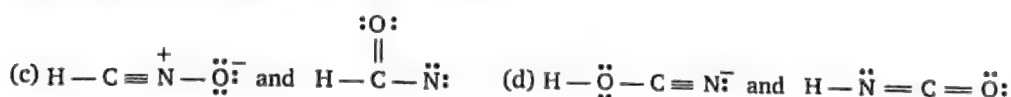
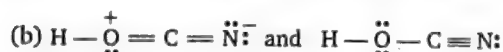
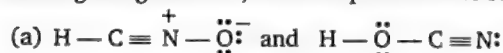


- (a)  $2 < 3 < 1$  (b)  $3 < 1 < 2$  (c)  $1 < 2 < 3$  (d)  $2 < 1 < 3$

84. Which of the following phenols has the largest  $pK_a$  value (i. e., is least acidic) ?



85. Among the given sets, which represents the resonating structures ?

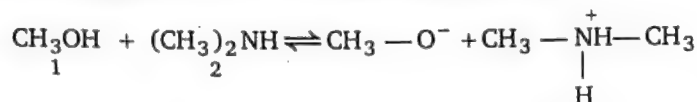




86. Identify each species in the following equilibrium according to the code :

SA = stronger acid ; SB = stronger base ; WA = weaker acid ; WB = weaker base.

The  $pK_a$  of  $(CH_3)_2NH$  is 36 ; the  $pK_a$  of  $CH_3OH$  is 15.2.



(a)  $\begin{matrix} 1 & 2 \\ WA & WB \end{matrix}$   
(e)  $\begin{matrix} 1 & 2 \\ WA & WA \end{matrix}$

(b)  $\begin{matrix} 1 & 2 \\ WB & WA \end{matrix}$

(c)  $\begin{matrix} 1 & 2 \\ SA & SB \end{matrix}$

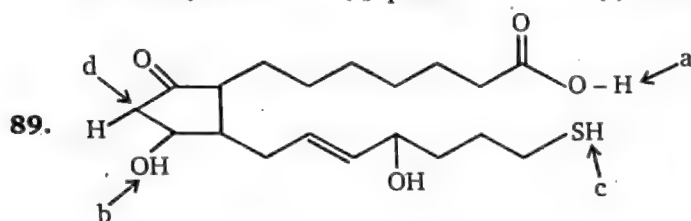
(d)  $\begin{matrix} 1 & 2 \\ SB & SA \end{matrix}$

87. The hydrogen bonding is strongest in which one of the following set ?

(a)  $F - H \cdots F$  (b)  $O - H \cdots S$  (c)  $S - H \cdots F$  (d)  $F - H \cdots O$

88. Intermolecular hydrogen bonding is strongest in :

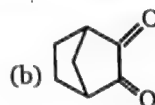
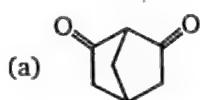
(a) methylamine (b) phenol (c) formaldehyde (d) methanol



Identify most acidic hydrogen in given compound.

(a) a (b) b (c) c (d) d

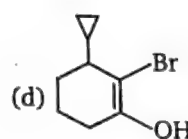
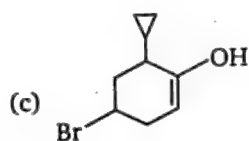
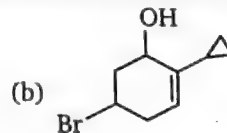
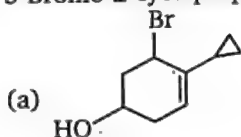
90. Which of the following compounds would you expect to be strongest carbon acid ?



(c)  $CH_2(CO_2Et)_2$

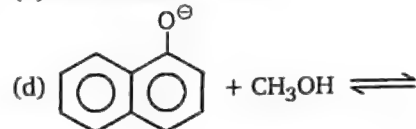
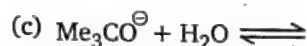
(d)  $CH_3COCH_2COOC_2H_5$

91. 5-Bromo-2-cyclopropyl cyclohex-2-enol have correct structure is:



92. Rearrange the following in the increasing order of acidic strength.  
 (i) benzoic acid (ii) *p*-methoxybenzoic acid (iii) *o*-methoxybenzoic acid  
 (a) i < ii < iii (b) iii < i < ii (c) ii < i < iii (d) iii < ii < i

93. In the following acid-base reaction, in which can backward reaction is favoured?



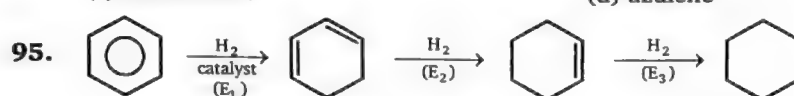
94. Which compound possesses highest dipole moment?

(a) naphthalene

(b) phenanthrene

(c) anthracene

(d) azulene



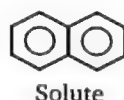
(E = activation energy)

Relation between activation energies of above reactions is :

- (a)  $E_2 > E_1 > E_3$  (b)  $E_3 > E_1 > E_2$  (c)  $E_3 > E_2 > E_1$  (d)  $E_1 > E_2 > E_3$

96. Rank the following solvents in decreasing order of ability to dissolve given compound.

Solvent
$\text{Et}_2\text{O}$
$\text{H}_2\text{O}$
$\text{EtOH}$

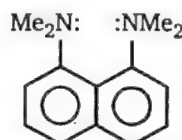


(a)  $\text{Et}_2\text{O} > \text{H}_2\text{O} > \text{EtOH}$

(b)  $\text{H}_2\text{O} > \text{EtOH} > \text{Et}_2\text{O}$

(c)  $\text{H}_2\text{O} > \text{Et}_2\text{O} > \text{EtOH}$

(d)  $\text{Et}_2\text{O} > \text{EtOH} > \text{H}_2\text{O}$



- 97.

1, 8-Bis (dimethylamino)  
naphthalene is after referred  
so as (Proton sponge)

Its basic strength is  $10^{10}$  more than 1-dimethyl amino naphthalene.

Reason for high basic strength is :

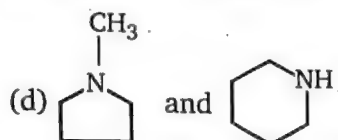
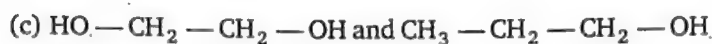
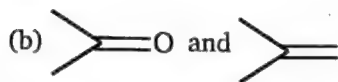
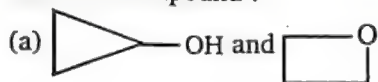
(a) resonance

(b) steric inhibition of resonance

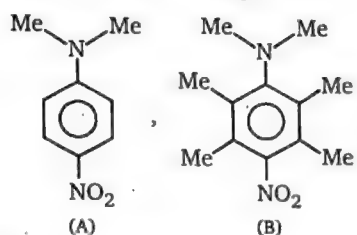
(c) ortho effect

(d) hyperconjugation

98. In the given pair of compounds, in which pair second compound has higher boiling point than first compound ?

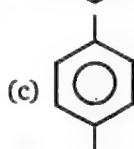
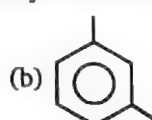
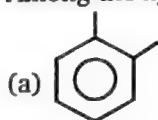


99.



Dipole moments of given compound will be :

- (a) (A) = 6.87D, (B) = 4.11D (b) (A) = 4.11 D , (B) = 6.87 D  
 (c) (A) = 4.11 D , (B) = 4.11 D (d) (A) = 6.87 D, (B) = 6.87 D
100. Order of decreasing basic strengths of halides is :  
 (a)  $\text{F}^- > \text{Cl}^- > \text{I}^- > \text{Br}^-$  (b)  $\text{F}^- > \text{Cl}^- > \text{Br}^- > \text{I}^-$   
 (c)  $\text{I}^- > \text{Br}^- > \text{Cl}^- > \text{F}^-$  (d)  $\text{I}^- > \text{Cl}^- > \text{Br}^- > \text{F}^-$
101. Among the xylenes, which is thermodynamically most stable ?



(d) All are equally stable

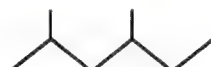
102. Heat of combustion of two isomer x and y are 17 kJ/mol and 12 kJ/mol respectively. From this information it may be concluded that :  
 (a) isomer x is 5 kJ/mol more stable  
 (b) isomer y is 5 kJ/mol less stable  
 (c) isomer y has 5 kJ/mol more potential energy  
 (d) isomer x is 5 kJ/mol less stable



103. Rank the following substances in decreasing order of heat of combustion (most exothermic  $\rightarrow$  least exothermic)



(A)



(B)



(C)

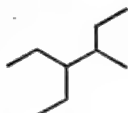
(a)  $B > A > C$

(b)  $A > B > C$

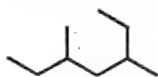
(c)  $C > A > B$

(d)  $C > B > A$

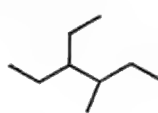
104.



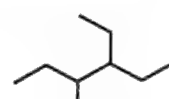
(1)



(2)



(3)



(4)

Choose the statement that best describes given compounds.

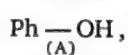
(a) 1, 3, 4 represent same compound

(b) 1 and 3 are isomer of 2 and 4

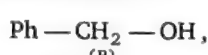
(c) 1, 4 are isomer of 2 and 3

(d) All the structure represent the same compound

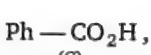
105. Decreasing order of acid strengths is :



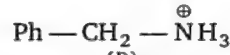
(A)



(B)



(C)



(D)

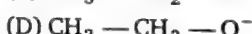
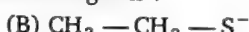
(a)  $B > A > C > D$

(b)  $C > A > B > D$

(c)  $C > A > D > B$

(d)  $C > B > A > D$

106. Rank the following in decreasing order of basic strength is :



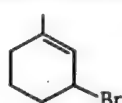
(a)  $B > A > D > C$

(b)  $D > A > B > C$

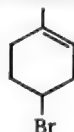
(c)  $A > D > B > C$

(d)  $A > D > C > B$

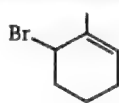
107. Among the given compound choose the two that yield same carbocation on ionization.



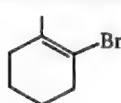
(A)



(B)



(C)



(D)

(a) A, C

(b) B, D

(c) A, B

(d) B, C

108. Oxalic acid

 $pK_1$ 

Malonic acid

 $pK_2$ 

Heptanedioic acid

 $pK_3$ 

where  $pK_1, pK_2, pK_3$  are first ionization constants. Incorrect order is :

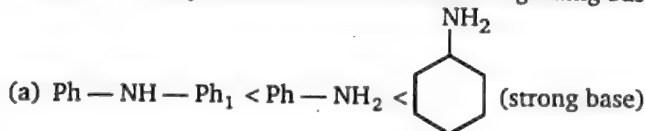
(a)  $pK_1 > pK_2 > pK_3$

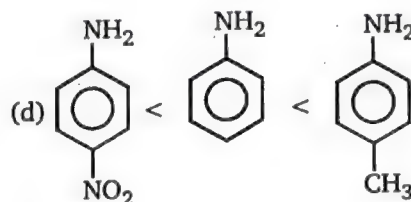
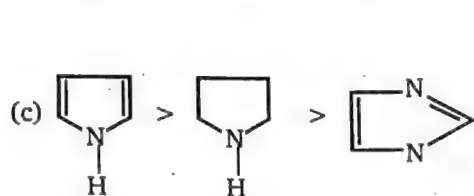
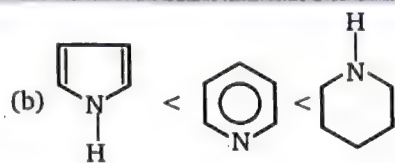
(b)  $pK_1 < pK_2 < pK_3$

(c)  $pK_3 > pK_2 > pK_1$

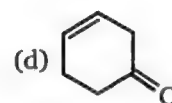
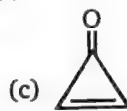
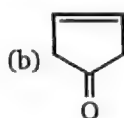
(d)  $pK_3 > pK_1 > pK_2$

109. In sets a - d, only one of the set is incorrect regarding basic strength. Select it :

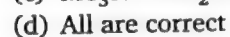
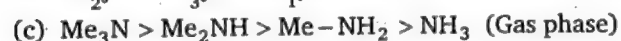
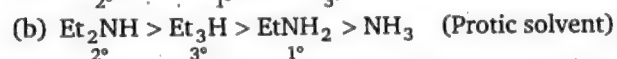
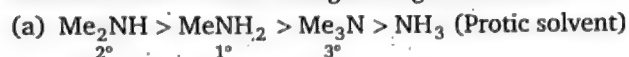




110. Dipole moment of which ketone is maximum ?



111. Correct order of basic strengths of given amines is :



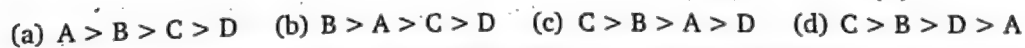
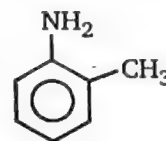
112. Order of basic strength  $\text{Ph}-\text{NH}_2$ ,  $\text{Ph}-\text{NH}-\text{Me}$ ,  $\text{Ph}-\text{N}(\text{Me})_2$

(A)

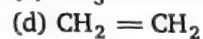
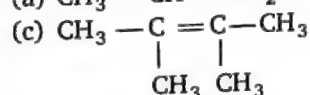
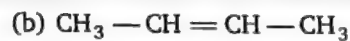
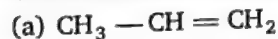
(B)

(C)

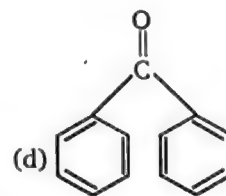
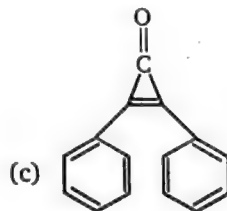
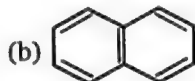
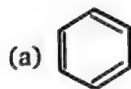
(D)

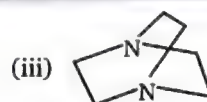
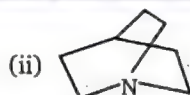


113. Carbon-carbon double bond length will be maximum in which of the following compounds ?



114. Which has maximum dipole moment ?

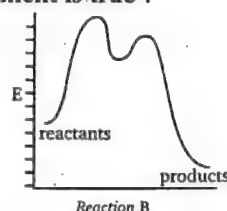
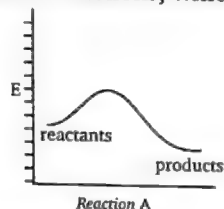


115. (i)  $\text{Et}_3\text{N}$ 

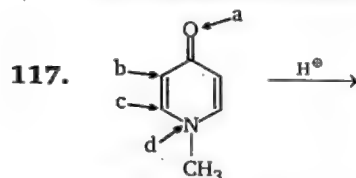
Compare the basic strengths of compounds given:

(a) (i) &gt; (ii) &gt; (iii) (b) (ii) &gt; (i) &gt; (iii) (c) (ii) &gt; (iii) &gt; (i) (d) (iii) &gt; (ii) &gt; (i)

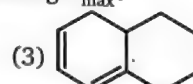
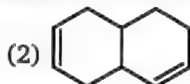
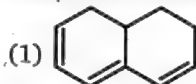
116. For the following two reactions, which statement is true ?



- (a) Reaction A is faster and less exergonic than B  
 (b) Reaction B is faster and more exergonic than A  
 (c) Reaction A is faster and less endergonic than B  
 (d) Reaction B is faster and more endergonic than A

Identify the site, where attack of  $\text{H}^+$  is most favourable.

- (a) a (b) b (c) c (d) d

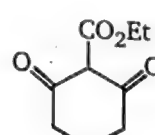
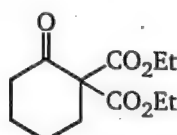
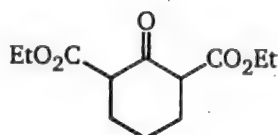
118. Rank the following alkenes on order of increasing  $\lambda_{\text{max}}$ .

- (a) 1 < 2 < 3 (b) 1 < 3 < 2 (c) 2 < 1 < 3 (d) 2 < 3 < 1

119. Which of the following cyclic amine has lowest  $\Delta G^\ddagger$  for inversion ?

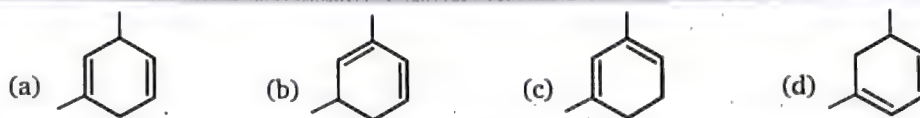
- (a) (b) (c) (d)

120. Rank in the order of increasing acidic strength:



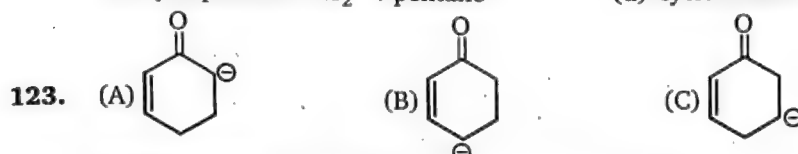
- (a) A < B < C (b) A < C < B (c) B < A < C (d) B < C < A

121. Which one of the following dienes would you expect to be the most stable ?



122. Which metal catalyzed reaction would release the maximum amount of heat per  $\text{CH}_2$  unit?

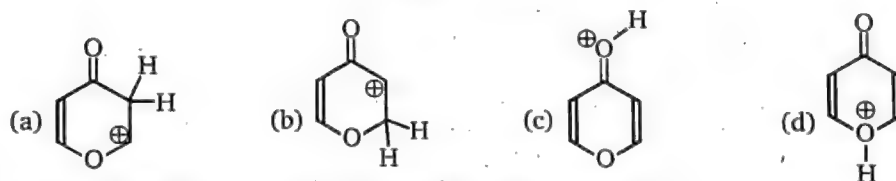
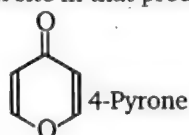
- (a) cyclopropane +  $\text{H}_2 \rightarrow$  propane  
 (b) cyclobutane +  $\text{H}_2 \rightarrow$  butane  
 (c) cyclopentane +  $\text{H}_2 \rightarrow$  pentane  
 (d) cyclohexane +  $\text{H}_2 \rightarrow$  hexane



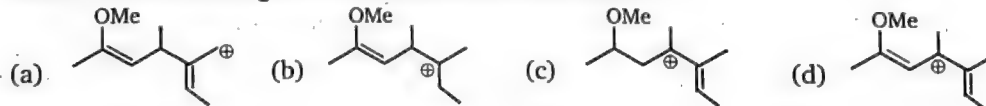
Compare basic strengths of the above compounds:

- (a)  $A > B > C$  (b)  $B > A > C$  (c)  $C > A > B$  (d)  $C > B > A$

124. On reaction with acid, 4-pyrone gives a very stable cationic product. Which of the following structures shows the protonation site in that product?



125. Which of the following is the most stabilized carbocation?



126. Which carbocation is the most stable?



127. Consider a positively charged  $\text{C}_2\text{H}_3$  species in which the positively charged carbon is  $sp$ -hybridized, the uncharged carbon is  $sp^2$ -hybridized and an empty  $p$ -orbital is perpendicular to the  $\pi$  system. What is the best description of this cation?

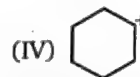
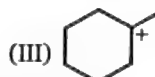
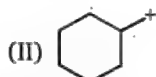
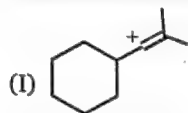
- (a) vinyl (b) allenyl (c) alkyl (d) allyl



128. Which of the following reactions is not exothermic ?

- (a)  $\text{CH}_3 - \text{Cl} + \text{CH}_3 - \text{CH}_3 \longrightarrow \text{CH}_4 + \text{CH}_3 - \text{CH}_2 - \text{Cl}$   
 (b)  $\text{CH}_3 - \text{Cl} + (\text{CH}_3)_3 \text{C} - \text{H} \longrightarrow \text{CH}_4 + (\text{CH}_3)_3 \text{C} - \text{Cl}$   
 (c)  $\text{CH}_3 - \text{Cl} + \text{CH}_2 = \text{CH} - \text{CH}_3 \longrightarrow \text{CH}_4 + \text{CH}_2 = \text{CH} - \text{CH}_2 - \text{Cl}$   
 (d)  $\text{CH}_3 - \text{Cl} + \text{CH}_2 = \text{CH}_2 \longrightarrow \text{CH}_4 + \text{CH}_2 = \text{CHCl}$

129. List the following carbocations in order of decreasing stabilization energies.



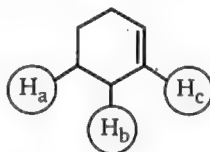
- (a) II, III, I, IV (b) III, IV, II, I (c) III, IV, I, II (d) I, II, IV, III

130. For the following two acid-base reactions, which statement is true ?



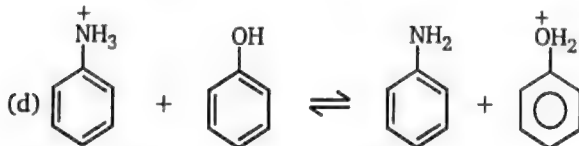
- (a) I is favoured to the right, II is favoured to the left  
 (b) I is favoured to the left, II is favoured to the right  
 (c) I is favoured to the right, II is favoured to the right  
 (d) I is favoured to the left, II is favoured to the left

131. Rank the hydrogen atoms ( $\text{H}_a$ ,  $\text{H}_b$ ,  $\text{H}_c$ ) in the following molecules according to their acidic strengths:

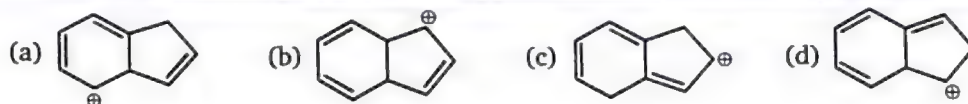


- (a)  $a > b > c$  (b)  $b > a > c$  (c)  $b > c > a$  (d)  $a > c > b$

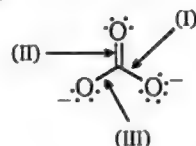
132. In which of the following reactions, backward reaction is favoured ?



133. Which carbocation is the most stabilized ?

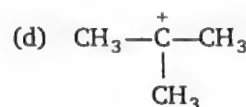
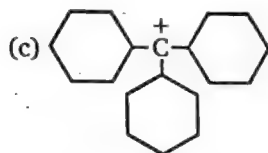
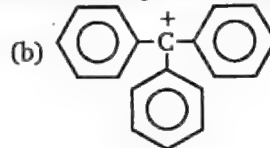
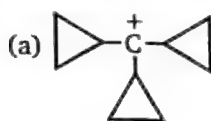


134. Taking into account of hybridization and resonance effects, rank the following bonds in order of decreasing bond length.

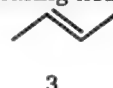
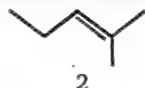
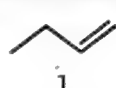


- (a)  $I > II = III$  (b)  $II > III > I$  (c)  $I > III > II$  (d)  $II = III = I$

135. Which one among the following carbocations has the longest half-life?

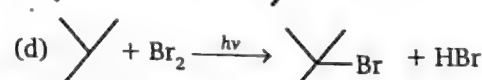
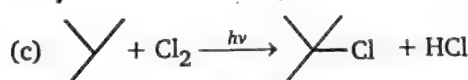
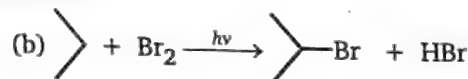
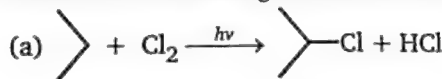


136. Rank the following alkenes in order of decreasing heats of hydrogenation (largest first)

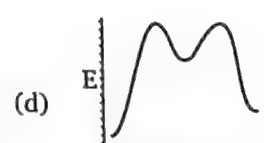
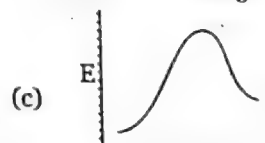
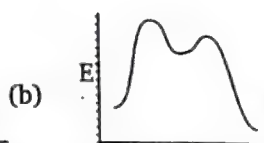
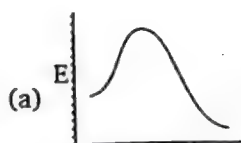
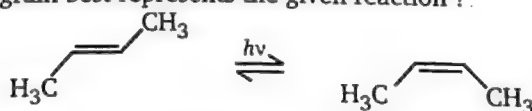


- (a)  $2 > 3 > 4 > 1$  (b)  $2 > 4 > 3 > 1$  (c)  $1 > 3 > 4 > 2$  (d)  $1 > 4 > 3 > 2$

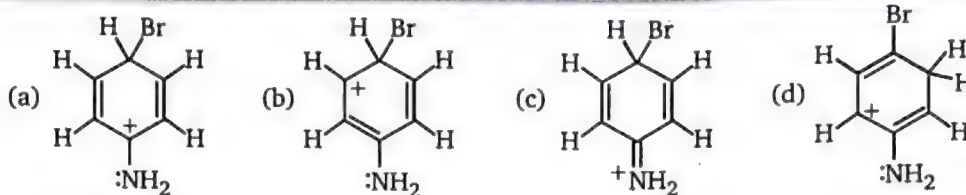
137. Which of the following reactions is most exothermic?



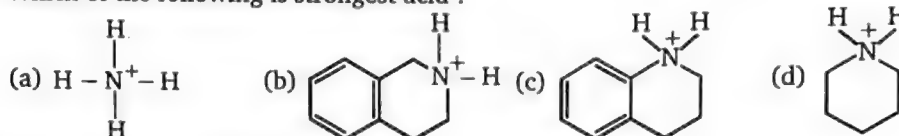
138. Which energy diagram best represents the given reaction?



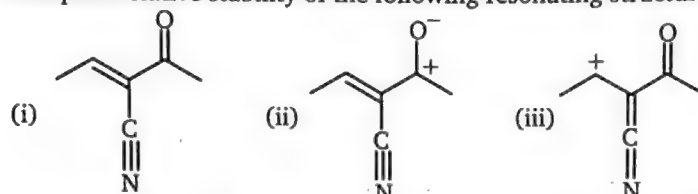
139. Which one of the following is most stable?



140. Which of the following is strongest acid ?

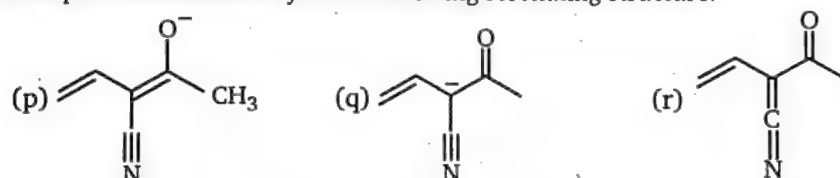


141. Compare relative stability of the following resonating structure.



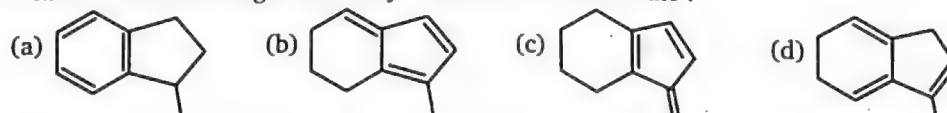
(a) (i) > (ii) > (iii) (b) (ii) > (i) > (iii) (c) (i) > (iii) > (ii) (d) (ii) > (iii) > (i)

142. Compare relative stability of the following resonating structure.



(a)  $p > q > r$  (b)  $q > p > r$  (c)  $q > r > p$  (d)  $p > r > q$

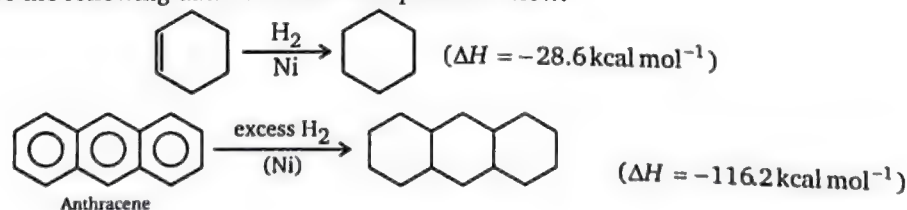
143. Which of the following isomeric hydrocarbons is most acidic ?



144. Which of the following has the lowest barrier to rotation about the indicated bond ?



145. Use the following data to answer the question below.



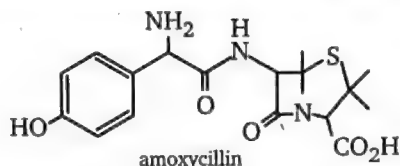
Calculate the resonance energy of anthracene:

- (a) 84 kcal/mol (b) 100 kcal/mol (c) 110 kcal/mol (d) 116 kcal/mol

146. How many double bond equivalents does a compound of molecular formula  $C_6H_{12}O_6$  possess?

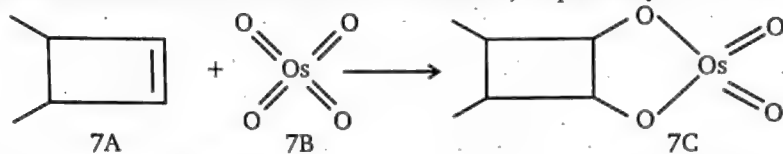
- (a) 0 (b) 1 (c) 2 (d) 3

147. How many double bond equivalents does amoxicillin (shown below) possess?



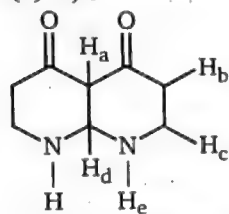
- (a) 5 (b) 6 (c) 7 (d) 9

148. What is the oxidation state of osmium in 7B and 7C, respectively?



- (a) 6, 8 (b) 8, 6 (c) 6, 6 (d) 8, 8

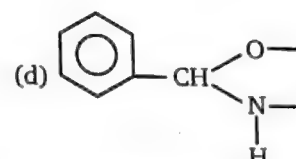
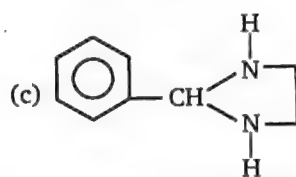
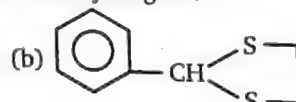
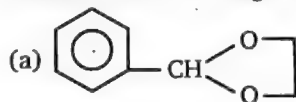
149.



Identify most acidic hydrogen present in the above compound:

- (a) a (b) b (c) c (d) d

150. Which of the following compounds has most acidic hydrogen?

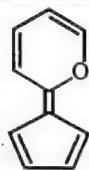


151. Acetic acid,  $(CH_3COOH)$ , has a  $pK_a$  of 4.8. Ethanol,  $(CH_3CH_2OH)$ , has a  $pK_a$  of 16.0. What are the major species present, when acetic acid and ethanol are added to water and the pH is adjusted to 7.0?

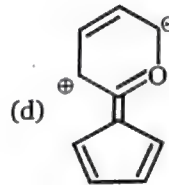
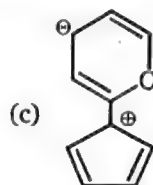
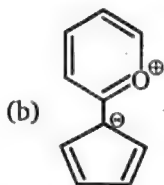
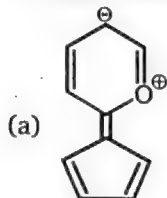
- (a)  $CH_3CO_2H$  and  $CH_3CO_2OH$  (b)  $CH_3CH_2O^-$  and  $CH_3CH_2OH$   
(c)  $CH_3CO_2H$  and  $CH_3CH_2O^-$  (d)  $CH_3CO_2^-$  and  $CH_3CH_2OH$



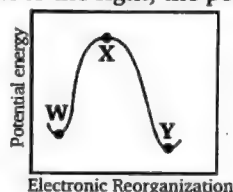
152.



The most stable canonical structure of given molecule is:



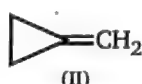
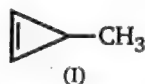
153. In the potential energy diagram to the right, the point X represents :



- (a) a transition state  
(c) a resonance hybrid

- (b) a reaction intermediate  
(d) a reactant

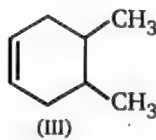
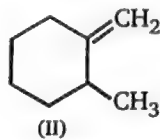
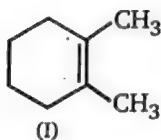
154.



Which of the following orders is correct for heat of hydrogenation of these compounds ?

- (a) I > III > II      (b) III > II > I      (c) III > I > II      (d) II > I > III

155.



Which of the following orders is correct for heat of hydrogenation of these compounds ?

- (a) I > II > III      (b) III > II > I      (c) II > III > I      (d) III > I > II

156.  $\text{CH}_2=\text{O} \longleftrightarrow \text{}^+\text{CH}_2-\text{O}^- \longleftrightarrow \text{}^-\text{CH}_2-\text{O}^+$

(I)

(II)

(III)

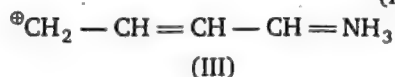
Which of these structures is practically not a valid canonical structure for formaldehyde ?

- (a) I      (b) II      (c) III      (d) None of these

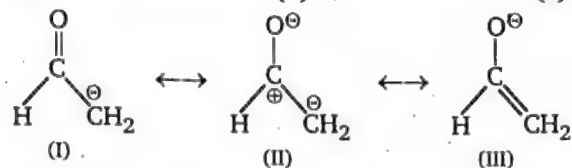
157.  $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}-\text{}^+\text{NH}_3; \quad \text{}^+\text{CH}_2-\text{CH}=\text{CH}-\text{}^-\text{CH}-\text{}^+\text{NH}_3$

(I)

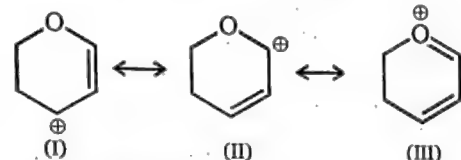
(II)




Which of these structures is not a valid canonical structure ?

- (a) I (b) II (c) III (d) none of these
158. 

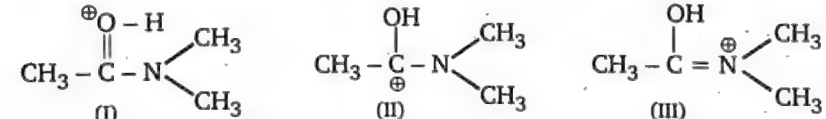
The correct order of stability for the given canonical structures is :

- (a) I > III > II (b) III > I > II (c) II > III > I (d) II > I > III
159. 

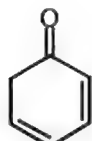
The most stable canonical structure among the given structure is :

- (a) I (b) II (c) III (d) all are equally stable
160. 

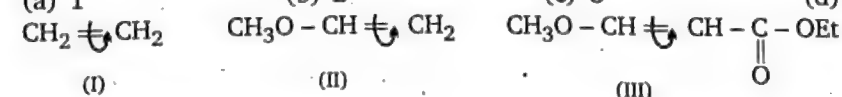
For the given compounds the correct order of resonance energy is :

- (a) III > I > II (b) II > I > III (c) I > II > III (d) III > II > I
161. 

The correct stability order of the given canonical structures is :

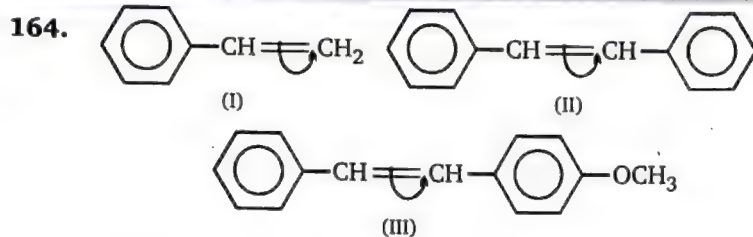
- (a) I > II > III (b) III > I > II (c) I > III > II (d) II > III > I
162. 

In the above compound, how many sites are available for the attack of  $\text{CH}_3\text{O}^-$  ?

- (a) 1 (b) 2 (c) 3 (d) 4
163. 

Which of the following orders of rotation barrier about the  $\text{C}=\text{C}$  bond, as indicated, is correct ?

- (a) I > II > III (b) III > II > I (c) III > I > II (d) II > I > III



Which of the following orders of rotation barrier about the  $C = C$  bond, as indicated, is correct?

- (a)  $I > II > III$  (b)  $III > II > I$  (c)  $III > I > II$  (d)  $II > I > III$

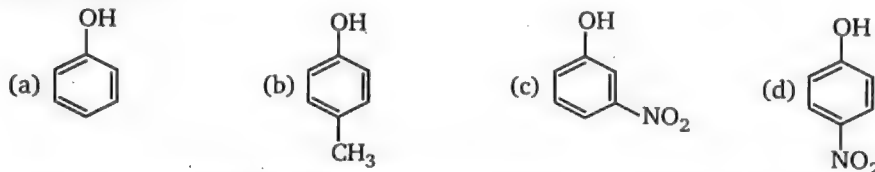
165. Which of the following compound is not resonance stabilized?



166. Homologous compound have same:

- (a) General formula (b) Empirical formula  
(c) Structural formula (d) Molecular formula

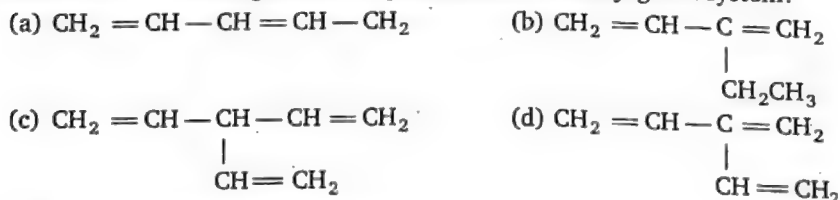
167. Most acidic is:



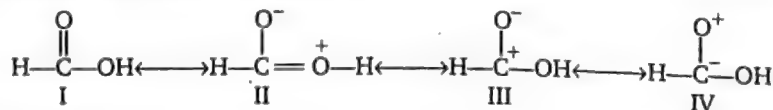
168. Which of the following substituents will decrease the acidic strength of phenol?

- (a)  $-\text{NO}_2$  (b)  $-\text{CN}$  (c)  $-\text{CH}_3$  (d)  $-\text{CHO}$

169. Which of the following structures possesses a cross-conjugated system?



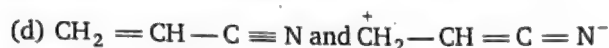
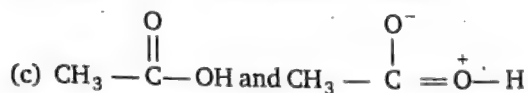
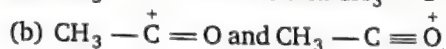
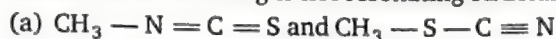
170. Examine the following resonating structures of formic acid for their individual stability and then answer the question given below.



Which of the following arrangements gives the correct order of decreasing stability of the above-mentioned resonance contributors?

- (a)  $II > I > III > IV$  (b)  $I > II > III > IV$  (c)  $IV > III > I > II$  (d)  $IV > III > I > II$

171. Which of the following is not resonating structure of each other?



172. In the molecule  $\text{CH}_3\text{C} \equiv \text{CCH} = \text{CH}_2$ , the maximum number of carbon atoms arranged linearly is:

(a) 2

(b) 3

(c) 4

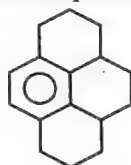
(d) 5

173. The stability order of the following carbocations is:



(a)  $\text{II} > \text{IV} > \text{III} > \text{I}$  (b)  $\text{IV} > \text{II} > \text{III} > \text{I}$  (c)  $\text{II} > \text{III} > \text{I} > \text{IV}$  (d)  $\text{I} > \text{III} > \text{II} > \text{IV}$

174. Total number of  $\alpha$ -hydrogen in given compound is:



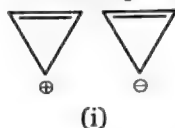
(a) 4

(b) 5

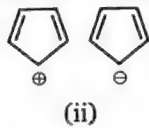
(c) 6

(d) 7

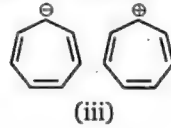
175. In which pair second ion is more stable than first?



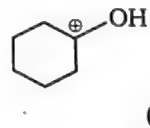
(i)



(ii)



(iii)



(iv)

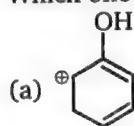
(a) (i) and (ii)

(b) (ii) and (iii)

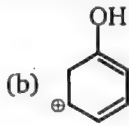
(c) (ii) and (iv)

(d) (iii) and (iv)

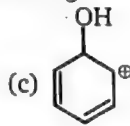
176. Which one is the most stable cation in the following?



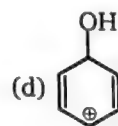
(a)



(b)

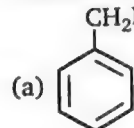


(c)

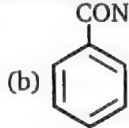


(d)

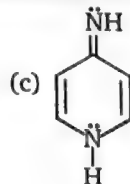
177. The most reactive amine towards dilute hydrochloric acid is \_\_\_\_\_.



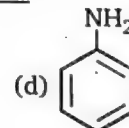
(a)



(b)



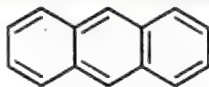
(c)



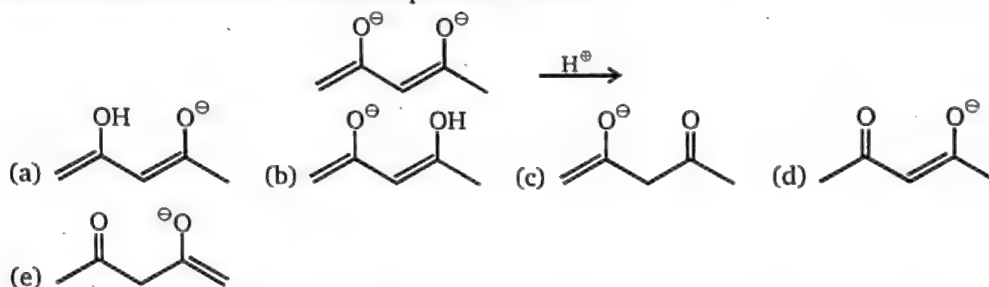
(d)



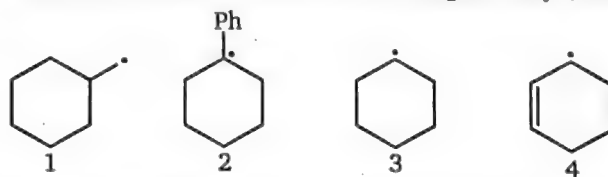
178. How many resonance structures are there for anthracene ?



- (a) 6 (b) 5 (c) 4 (d) 2
179. Which base is strong enough to convert  $(\text{CH}_3)_3\text{COH}$  into  $(\text{CH}_3)_3\text{CONa}$  in a reaction that goes to completion ?
- (a)  $\text{NaNH}_2$  (b)  $\text{CH}_3\text{CH}_2\text{Na}$  (c)  $\text{NaOH}$  (d)  $\text{CH}_3\text{CO}_2\text{Na}$   
 (e) More than one of the above
180. Based upon an understanding of product stability, predict the product formed when the following dianion reacts with one equivalent of acid



181. Rank the following alkyl radicals in order of increasing stability (least < < < most).



- (a)  $4 < 2 < 1 < 3$  (b)  $3 < 1 < 2 < 4$  (c)  $1 < 3 < 4 < 2$  (d)  $2 < 4 < 3 < 1$
182. Among the given cations, the most stable carbonium ion is ?
- (a) sec-butyl (b) tert-butyl (c) n-butyl (d) None of these
183. Cyclohexadiene contains \_\_\_\_ vinylic and \_\_\_\_ allylic hydrogen atoms ?



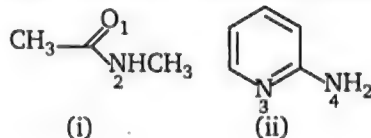
- (a) 2 and 2 respectively (b) 4 and 4 respectively  
 (c) 2 and 4 respectively (d) 4 and 2 respectively
184. The dipole moments of halo compounds are in the order
- (a)  $\text{CHCl}_3 > \text{CCl}_4 > \text{CHCl}_2 > \text{cis-CHCl=CHCl}$   
 (b)  $\text{cis-CHCl=CHCl} > \text{CHCl}_3 > \text{CH}_2\text{Cl}_2 > \text{CCl}_4$   
 (c)  $\text{cis-CHCl=CHCl} > \text{CH}_2\text{Cl}_2 > \text{CHCl}_3 > \text{CCl}_4$   
 (d)  $\text{CHCl}_3 > \text{CHCl}_2 > \text{cis-CHCl=CHCl} > \text{CCl}_4$
185. The  $\text{pK}_a$  value in  $\text{H}_2\text{O}$  of picric acid, acetic acid and phenol are in the order :
- (a) Picric acid 0.4, acetic acid 4.75, phenol 10.0

(b) Acetic acid 0.4, picric acid 4.75, phenol 10.0

(c) Picric acid 0.4 phenol 4.75, acetic acid 10.0

(d) Phenol 0.4, acetic acid 4.75 picric acid 10.0

186. The preferred sites of protonation in the following compounds are:



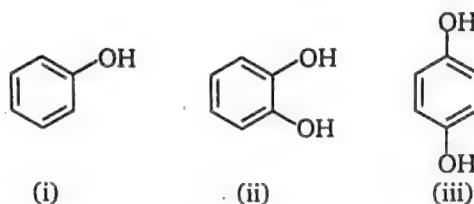
(a) 1 and 3

(b) 2 and 4

(c) 1 and 4

(d) 2 and 3

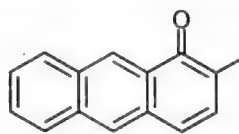
187. Among i-iii



the boiling point follows the order

(a) (ii) < (i) < (iii) (b) (iii) < (ii) < (i) (c) (i) < (ii) < (iii) (d) (ii) < (iii) < (i)

188. The number of C — C sigma bonds in the compound



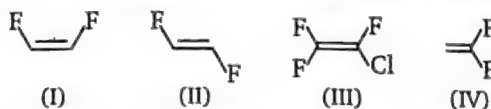
(a) 16

(b) 14

(c) 18

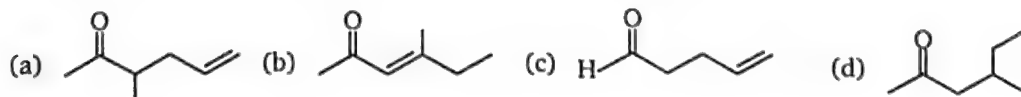
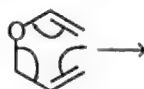
(d) 11

189. The correct order of dipole moment for the following molecules is



(a) IV > I > III > II (b) I > IV > III > II (c) III > I > II > IV (d) II > III > IV > I

190. Curved arrows are used in Organic Chemistry to show the movement of electrons in the mechanism of a reaction. The correct product of the following reaction is

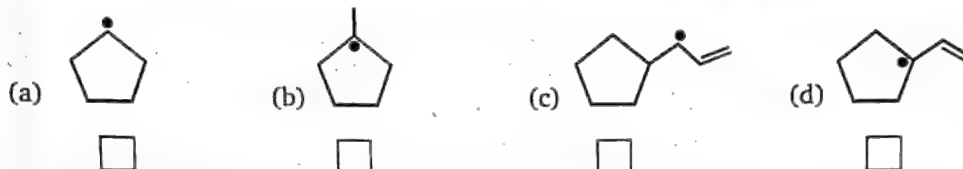


ANSWERS — LEVEL 1															
1.	(c)	2.	(d)	3.	(d)	4.	(a)	5.	(d)	6.	(d)	7.	(b)	8.	(c)
9.	(b)	10.	(c)	11.	(b)	12.	(b)	13.	(a)	14.	(b)	15.	(b)	16.	(b)
17.	(d)	18.	(c)	19.	(d)	20.	(d)	21.	(c)	22.	(c)	23.	(c)	24.	(a)
25.	(d)	26.	(d)	27.	(d)	28.	(a)	29.	(d)	30.	(a)	31.	(c)	32.	(c)
33.	(d)	34.	(d)	35.	(d)	36.	(d)	37.	(b)	38.	(b)	39.	(a)	40.	(c)
41.	(c)	42.	(d)	43.	(a)	44.	(c)	45.	(c)	46.	(d)	47.	(b)	48.	(d)
49.	(b)	50.	(b)	51.	(d)	52.	(d)	53.	(d)	54.	(a)	55.	(c)	56.	(c)
57.	(b)	58.	(b)	59.	(d)	60.	(c)	61.	(b)	62.	(b)	63.	(d)	64.	(c)
65.	(d)	66.	(c)	67.	(a)	68.	(a)	69.	(d)	70.	(b)	71.	(a)	72.	(d)
73.	(d)	74.	(d)	75.	(a)	76.	(d)	77.	(a)	78.	(a)	79.	(b)	80.	(a)
81.	(d)	82.	(d)	83.	(d)	84.	(c)	85.	(b)	86.	(a)	87.	(a)	88.	(b)
89.	(a)	90.	(d)	91.	(b)	92.	(c)	93.	(d)	94.	(d)	95.	(d)	96.	(d)
97.	(b)	98.	(d)	99.	(a)	100.	(b)	101.	(b)	102.	(d)	103.	(a)	104.	(a)
105.	(c)	106.	(c)	107.	(c)	108.	(b)	109.	(c)	110.	(c)	111.	(d)	112.	(c)
113.	(c)	114.	(c)	115.	(c)	116.	(a)	117.	(a)	118.	(d)	119.	(c)	120.	(c)
121.	(c)	122.	(a)	123.	(c)	124.	(c)	125.	(d)	126.	(b)	127.	(a)	128.	(d)
129.	(b)	130.	(a)	131.	(c)	132.	(d)	133.	(c)	134.	(d)	135.	(a)	136.	(d)
137.	(c)	138.	(d)	139.	(c)	140.	(c)	141.	(a)	142.	(d)	143.	(b)	144.	(c)
145.	(a)	146.	(b)	147.	(d)	148.	(b)	149.	(a)	150.	(b)	151.	(d)	152.	(b)
153.	(a)	154.	(a)	155.	(c)	156.	(c)	157.	(c)	158.	(b)	159.	(c)	160.	(c)
161.	(b)	162.	(c)	163.	(a)	164.	(a)	165.	(c)	166.	(a)	167.	(d)	168.	(c)
169.	(d)	170.	(b)	171.	(a)	172.	(c)	173.	(c)	174.	(c)	175.	(b)	176.	(b)
177.	(c)	178.	(c)	179.	(e)	180.	(d)	181.	(c)	182.	(b)	183.	(b)	184.	(c)
185.	(a)	186.	(a)	187.	(a)	188.	(b)	189.	(b)	190.	(c)				



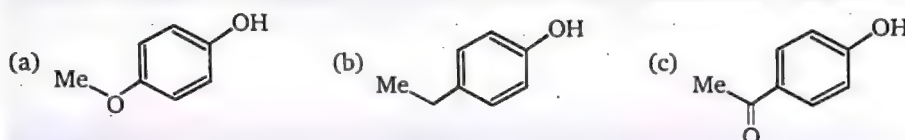
# LEVEL-2

1. Rank in order of radical stability (1 = most stable).



2. Predict the acidity order for the three phenols shown below :

Acidity order : 1 (most) to 3 (least)

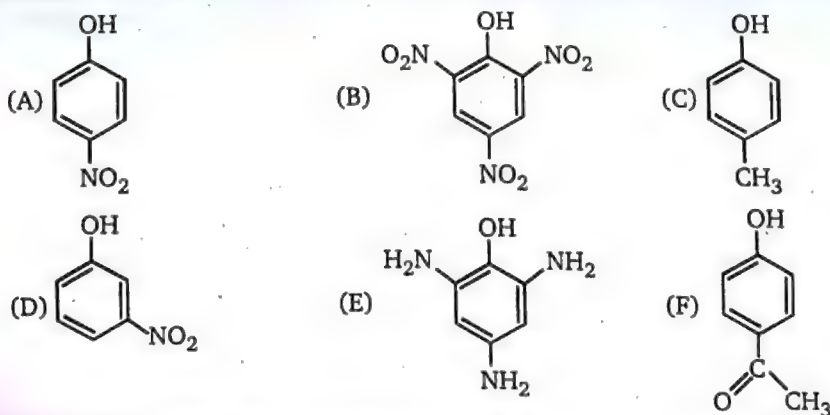


Acidity order : .....

.....

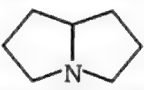
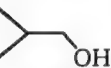
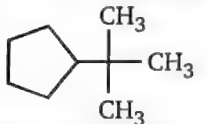

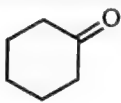
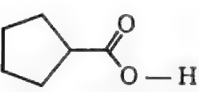
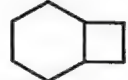
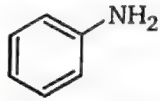
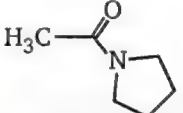
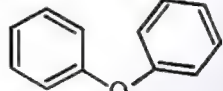
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### 3. Comprehension

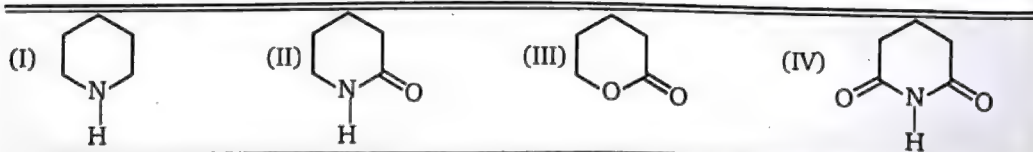




- A. Which of the phenol derivatives above is the strongest acid ?
- ☐ Compound A      ☐ Compound B      ☐ Compound C  
☐ Compound D      ☐ Compound E      ☐ Compound F
- B. Which of the phenol derivatives above is the weakest acid ?
- ☐ Compound A      ☐ Compound B      ☐ Compound C  
☐ Compound D      ☐ Compound E      ☐ Compound F
- C. Which of the mono-nitrophenol derivatives above is the strongest acid ?
- ☐ Compound A      ☐ Compound D
- D. Which of the carbon-substituted phenol derivatives above is the strongest acid ?
- ☐ Compound C      ☐ Compound F
4. The following questions refer to the twelve compounds given below. You may enter as many as six choices in each answer box.

(a)		(b)		(c)	$\text{H}_3\text{C}-\text{C}(=\text{O})-\text{O}-\text{C}_2\text{H}_5$
(d)	$\text{H}-\text{F}$	(e)		(f)	
(g)		(h)		(i)	
(j)		(k)		(l)	

- A. Which compound may serve only as H-bond acceptors ?
- B. Which may serve both as H-bond donors and acceptors?
- C. Which compounds will not participate in H-bonding ?
5. Consider the following compounds and answer A and B.



- A. Which of the compounds is the strongest Bronsted acid ?
- (a) I      (b) II      (c) III      (d) IV

B. Which of the compounds is the strongest Lewis base ?

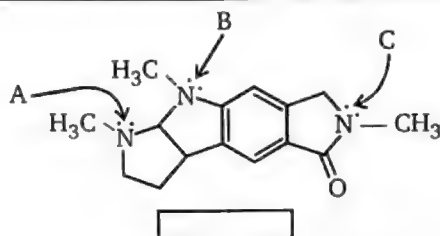
(a) I

(b) II

(c) III

(d) IV

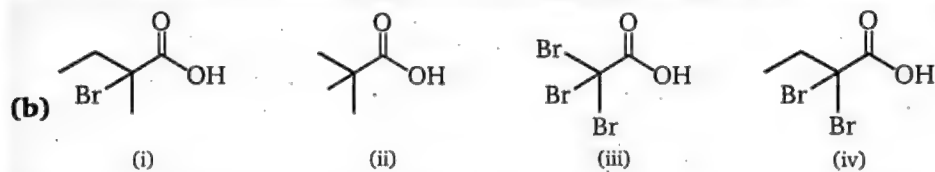
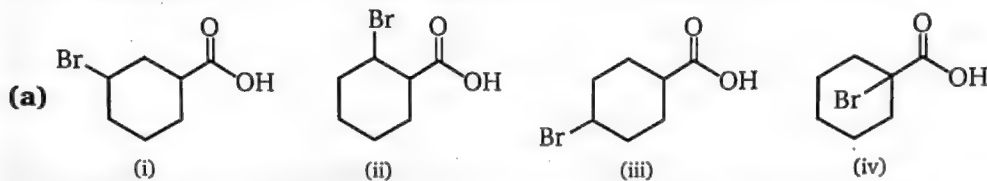
6. Rank the non-bonding electrons indicated by the arrows in order of increasing energy.



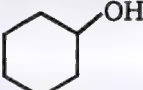
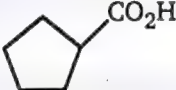
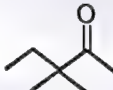
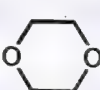
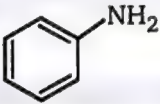
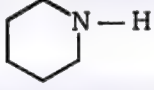
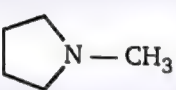
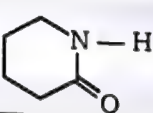
7. In each of the following sections four nitrogen containing compounds are listed. In the box under each formula write a number (1 to 4) indicating the order of base strength.

(a)				
(b)				
(c)				
(d)				

8. For the two sets of acids shown below, rank their acidity most acidic to least acidic.

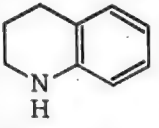
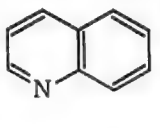
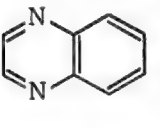
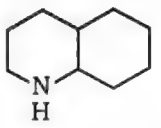
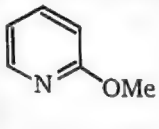
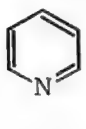
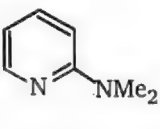
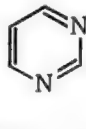


9. In each of the following sections four compounds are listed. In the box under each formula enter a number (1 to 4) indicating the order of acid strength (1 is strongest & 4 is weakest).

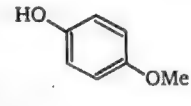
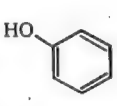
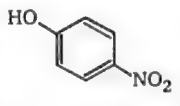
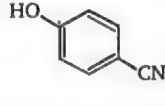
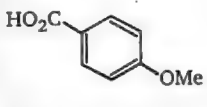
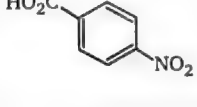
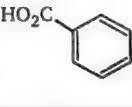
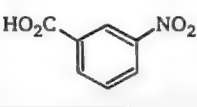
(a)	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$	$\text{CH}_3\text{CH}_2\text{CHBrCO}_2\text{H}$	$\text{ClCH}_2\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$	$\text{CH}_3\text{CCl}_2\text{CO}_2\text{H}$
(b)	$\text{C}_6\text{H}_5\text{CH}_2\text{OH}$	$\text{C}_6\text{H}_5\text{CO}_2\text{H}$	$\text{C}_6\text{H}_5\text{OCH}_3$	$\text{C}_6\text{H}_5\text{OH}$
(c)				
(d)				

10. In the two questions below, you are asked to rank the relative strengths of illustrated acids and bases. Use your knowledge of resonance and inductive to answer this.

A. For the series of bases shown below, rank the set from strongest to weakest.

(i)						Strongest
	(a)	(b)	(c)	(d)		Weakest
(ii)						Strongest
	(a)	(b)	(c)	(d)		Weakest

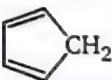
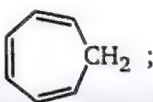
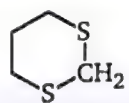
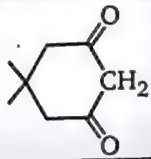
B. For the series of acids shown below, rank the set from strongest to weakest.

(i)						Strongest
	(a)	(b)	(c)	(d)		Weakest
(ii)						Strongest
	(a)	(b)	(c)	(d)		Weakest

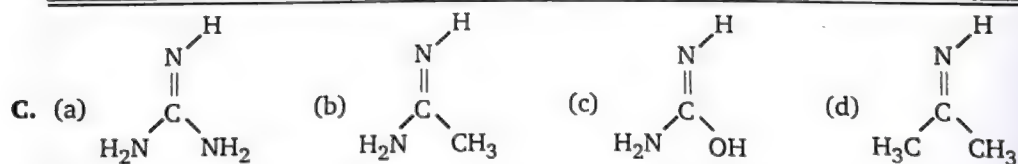
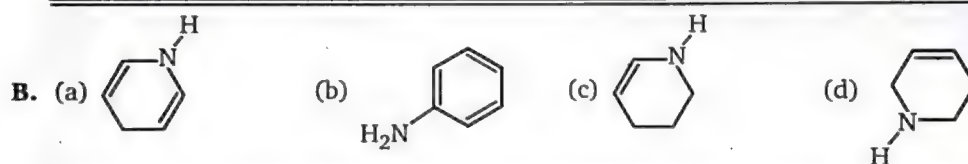
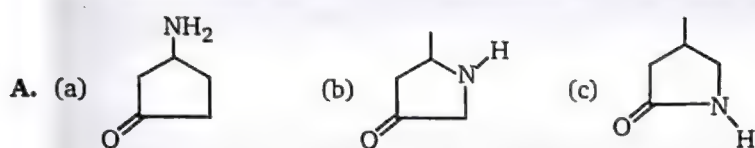
11. In each of the following sections four compounds are listed. (Decreasing order of acidic strength, 1 is strongest & 4 is weakest).

(a)	$\text{CH}_2(\text{CO}_2\text{C}_2\text{H}_5)_2$	$\text{CH}_3\text{COCH}_2\text{CO}_2\text{C}_2\text{H}_5$	$(\text{CH}_3\text{CO})_2\text{CH}_2$	$\text{RC}\equiv\text{CH}$
(b)	$\text{RCH}_2\text{NO}_2$	$\text{RSO}_2\text{CH}_3$	$(\text{C}_6\text{H}_5)_3\text{CH}$	$\text{RCOCH}_3$
(c)	$\text{CH}_2(\text{C}\equiv\text{N})_2$	$\text{CH}_2(\text{NO}_2)_2$	$\text{HC}\equiv\text{N}$	$\text{RCH}_2\text{CO}_2\text{C}_2\text{H}_5$

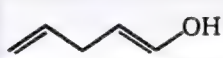


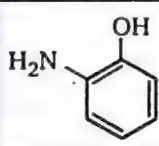
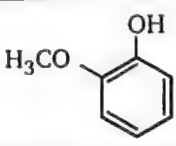
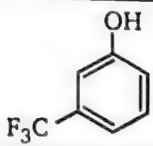


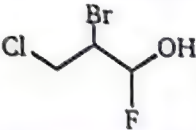
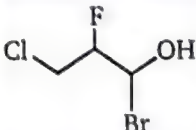
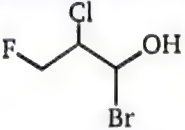
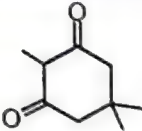
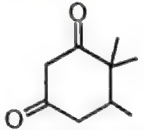
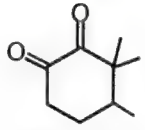
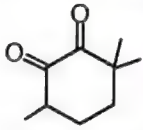
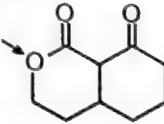
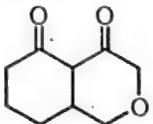
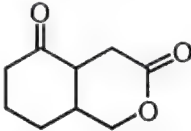
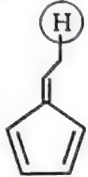
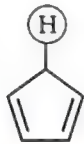
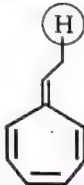
(d)				

12. Rank in the order of increasing basic strength.

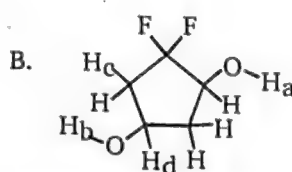
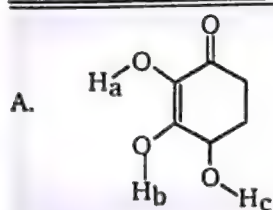


13. Compare acidic strength of the following (Write your answer in box).

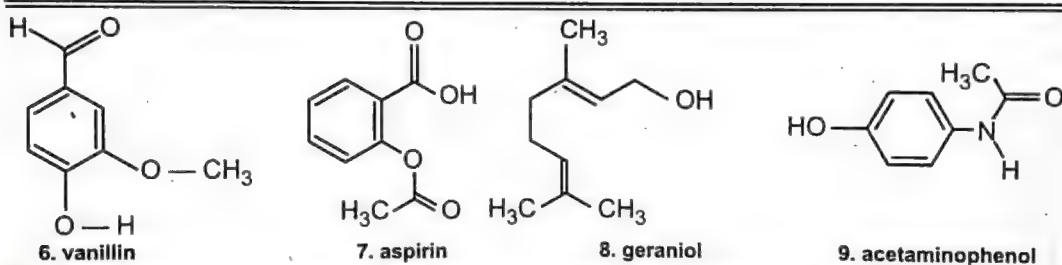
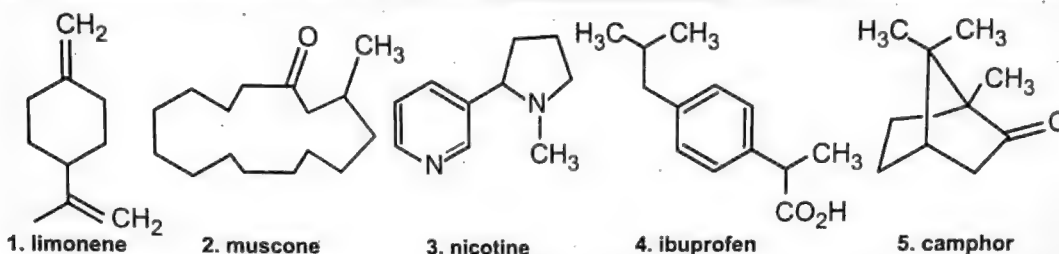
A.					
	(a)	(b)	(c)		
B.					
	(a)	(b)	(c)		

C.						
	(a)	(b)	(c)			
D.						
	(a)	(b)	(c)	(d)		
E.						
	(a)	(b)	(c)			
F.						
	(a)	(b)	(c)			

14. Arrange the hydrogens in increasing order of their acidic strengths.


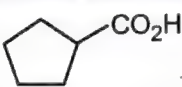
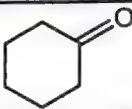
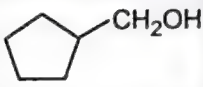
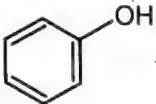
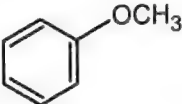
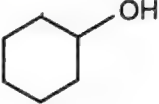
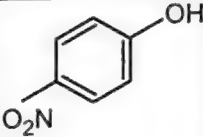
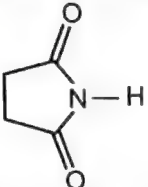
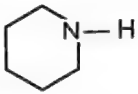
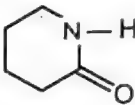
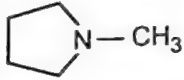
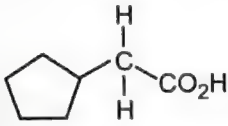
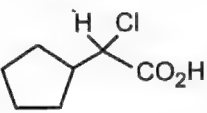
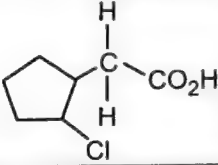
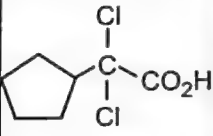


15. The compounds whose structures are shown below, incorporate a variety of functional groups. The question on the right ask you to identify which compounds have a specific functional group. For each compound that has the designed group, enter the appropriate number. The aromatic rings should not be counted as double bonds.



<b>A.</b>	Which have carbon-carbon double bonds ?	
<b>B.</b>	Which have a ketone carbonyl group ?	
<b>C.</b>	Which have an aldehyde carbonyl group ?	
<b>D.</b>	Which have aromatic rings ?	
<b>E.</b>	Which have a hydroxy group ?	
<b>F.</b>	Which have ether groups ?	
<b>G.</b>	Which have an ester group ?	
<b>H.</b>	Which have an amide group ?	
<b>I.</b>	Which have a carboxylic acid group ?	

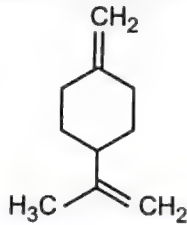
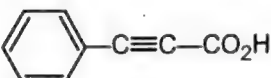
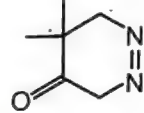
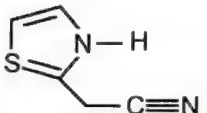
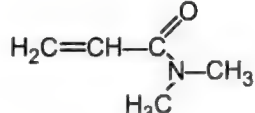
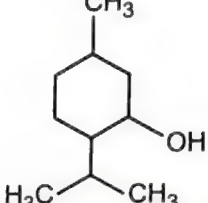
16.

Problem	A	B	C	D
1				
2				
3				
4				

- A. Which is the strongest acid in 1?  
 (a) A (b) B (c) C (d) D
- B. Which is weakest acid in 1?  
 (a) A (b) B (c) C (d) D
- C. Which is the strongest acid in 2?  
 (a) A (b) B (c) C (d) D
- D. Which is weakest acid in 2?  
 (a) A (b) B (c) C (d) D
- E. Which is the strongest acid in 3?  
 (a) A (b) B (c) C (d) D
- F. Which is weakest acid in 3?  
 (a) A (b) B (c) C (d) D
- G. Which is the strongest acid in 4?  
 (a) A (b) B (c) C (d) D
- H. Which is weakest acid in 4?  
 (a) A (b) B (c) C (d) D







17. For each of the six structural formulae (A through F), shown below, five questions are posed. The answer to each is a number that should be entered in the appropriate answer box.

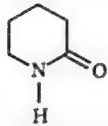
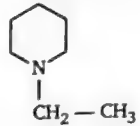
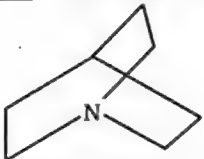
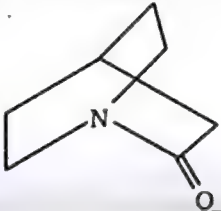
		
A	B	C
		
D	E	F

- |   |   |   |
|---|---|---|
| <p><b>A.</b> (i) Number of <math>sp^3</math> carbons : .....</p> <p>(ii) Number of <math>sp^2</math> carbons : .....</p> <p>(iii) Number of <math>sp</math> carbons : .....</p> <p>(iv) Number of carbon-carbon <math>\sigma</math>-bonds : .....</p> <p>(v) Number of <math>\pi</math>-bonds to carbon : .....</p> | <p><b>B.</b> Number of <math>sp^3</math> carbons : .....</p> <p>Number of <math>sp^2</math> carbons : .....</p> <p>Number of <math>sp</math> carbons : .....</p> <p>Number of carbon-carbon <math>\sigma</math>-bonds : .....</p> <p>Number of <math>\pi</math>-bonds to carbon : .....</p> | <p><b>C.</b> Number of <math>sp^3</math> carbons : .....</p> <p>Number of <math>sp^2</math> carbons : .....</p> <p>Number of <math>sp</math> carbons : .....</p> <p>Number of carbon-carbon <math>\sigma</math>-bonds : .....</p> <p>Number of <math>\pi</math>-bonds to carbon : .....</p> |
| <p><b>D.</b> (i) Number of <math>sp^3</math> carbons : .....</p> <p>(ii) Number of <math>sp^2</math> carbons : .....</p> <p>(iii) Number of <math>sp</math> carbons : .....</p> <p>(iv) Number of carbon-carbon <math>\sigma</math>-bonds : .....</p> <p>(v) Number of <math>\pi</math>-bonds to carbon : .....</p> | <p><b>E.</b> Number of <math>sp^3</math> carbons : .....</p> <p>Number of <math>sp^2</math> carbons : .....</p> <p>Number of <math>sp</math> carbons : .....</p> <p>Number of carbon-carbon <math>\sigma</math>-bonds : .....</p> <p>Number of <math>\pi</math>-bonds to carbon : .....</p> | <p><b>F.</b> Number of <math>sp^3</math> carbons : .....</p> <p>Number of <math>sp^2</math> carbons : .....</p> <p>Number of <math>sp</math> carbons : .....</p> <p>Number of carbon-carbon <math>\sigma</math>-bonds : .....</p> <p>Number of <math>\pi</math>-bonds to carbon : .....</p> |

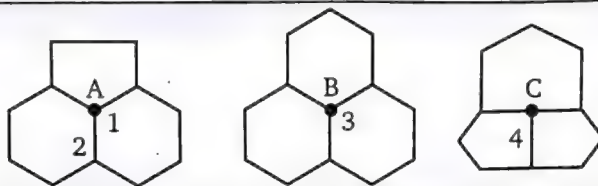
## 18. Match the column (I) and (II). (Matrix)

Column (I)		Column (II)	
	Molecule		Property
(a)		(p)	<i>cis</i> -compound
(b)		(q)	<i>trans</i> -compound
(c)		(r)	Highest heat of combustion
(d)		(s)	lowest heat of combustion

## 19. Match the column (I) and (II).

Column (I)		Column (II)	
	Molecule		$pK_a$ of Conjugate acid
(a)		(p)	0.8
(b)		(q)	5.33
(c)		(r)	10.65
(d)		(s)	10.95

20. The junctures centred on atoms A, B and C on the given structure.



- A. Which juncture has the greatest deviation from planarity ?  
 (a) A (b) B (c) C (d) Cannot be predicted
- B. Of the carbon-carbon bonds, (shown above) numbered from 1 to 4, which represent the most favourable site for  $H_2$  addition ?  
 (a) 1 (b) 2 (c) 3 (d) 4
21. Select the most stable structure in each of the following

Part (A)			
(a)	(b)	(c)	(d)
Part (B)			
(a)	(b)	(c)	(d)
Part (C)			
(a) $H_2C=CH-CH=CH-CH_3$	(b) $H_2C=C=CH-CH_2-CH_3$		
(c) $H_3C-CH=C=CH-CH_3$	(d) $H_2C=CH-CH_2-CH=CH_2$		

22. Match the column I and II. (Matrix)

Column (I)		Column (II)	
(a)	$-NO_2$	(p)	$-m$ effect
(b)	$-O^-$	(q)	$+m$ effect
(c)	$-O-CH_3$	(r)	$+I$ effect
(d)	$-C \equiv N$	(s)	$-I$ effect

23. Match the column I and II. (Matrix)

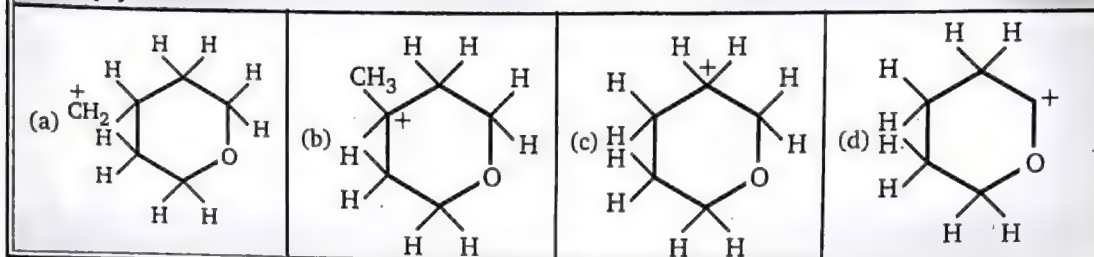
Column (I)		Column (II)	
(a)	$H_3C-CH=CH-CH_3$	(p)	Dipole ( $cis > trans$ )
(b)	$H_3C-CH=CH-CN$	(q)	Dipole ( $trans > cis$ )
(c)	$H_3C-CH=CH-Cl$	(r)	Melting point ( $(trans > cis)$ )
(d)	$Cl-CH=CH-Cl$	(s)	Boiling point ( $cis > trans$ )

24. Identify the most stable structure in each of the following :

Part (A)			
(a)	(b)	(c)	(d)
Part (B)			
(a)	(b)	(c)	(d)
Part (C)			
(a)	(b)	(c)	(d)
Part (D)			
(a)	(b)	(c)	(d)
Part (E)			
(a)	(b)	(c)	(d)
Part (F)			
(a)	(b)	(c)	(d)

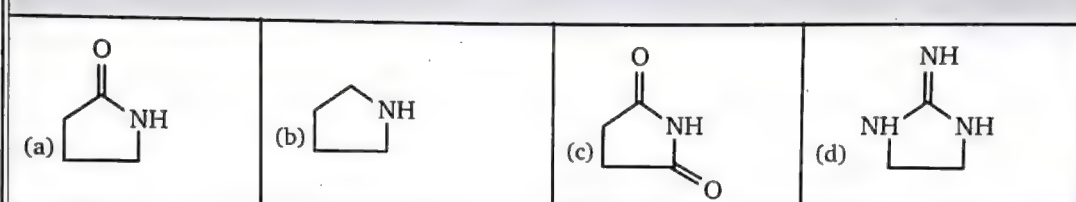


## Part (G)

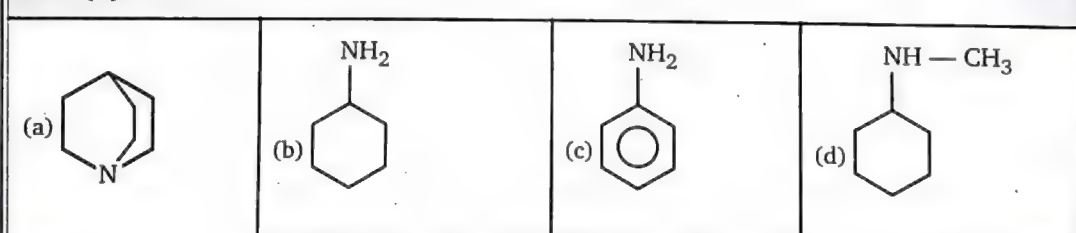


25. Identify the most basic compound in the following.

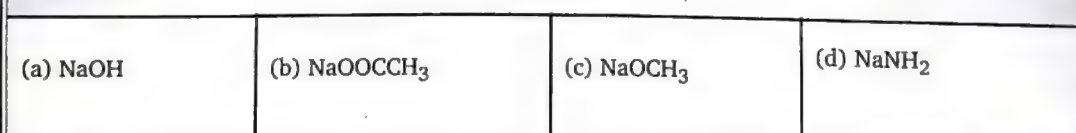
## Part (A)



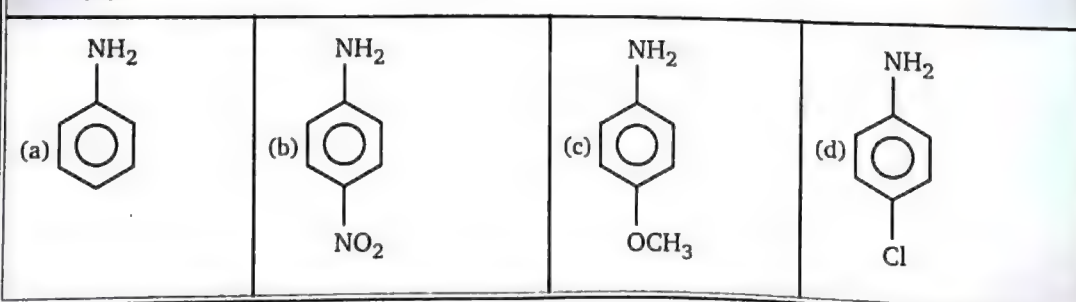
## Part (B)



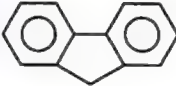
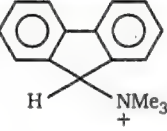
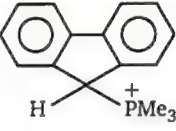
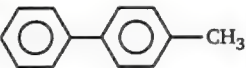

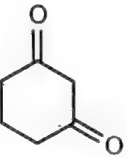
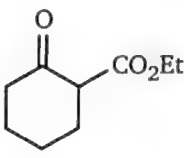
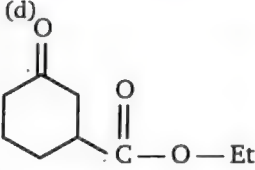
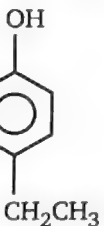
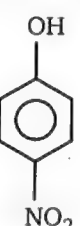
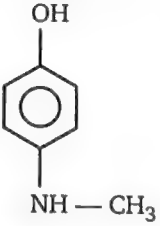
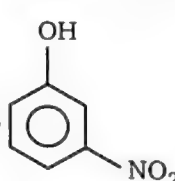
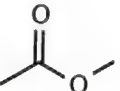
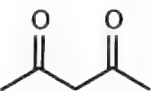

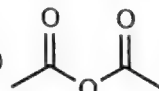
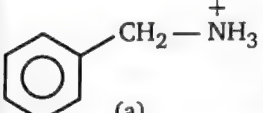
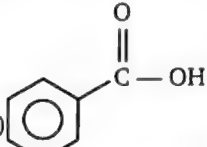
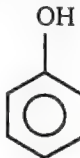
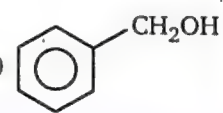
## Part (C)



## Part (D)

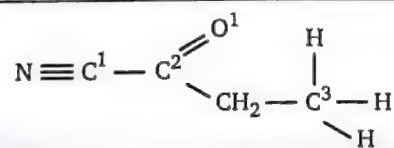


26. Identify the most acidic hydrogen containing compound from the following.

Part (A)			
(a) 	(b) 	(c) 	(d) 
Part (B)			
(a) 	(b) 	(c) 	(d) 
Part (C)			
(a) 	(b) 	(c) 	(d) 
Part (D)			
(a) 	(b) 	(c) 	(d) 
Part (E)			
(a) 	(b) 	(c) 	(d) 

Part (F)			
(a) $\text{CH}_3\text{CH}_2\text{OH}$	(b) $\text{CH}_3\text{CH}_2\text{NH}_2$	(c) $\text{CH}_3 - \text{C} \equiv \text{CH}$	(d) $\text{CH}_3 - \text{CH} = \text{CH}_2$
Part (G)			
(a) $\text{CH}_3 - \text{CO}_2\text{H}$	(b) $\begin{array}{c} \text{CH}_2 - \text{CO}_2\text{H} \\   \\ \text{NH}_3^+ \end{array}$	(c) $\begin{array}{c} \text{NH}_3^+ \\   \\ \text{C}_6\text{H}_5 \end{array}$	(d) $\begin{array}{c} \text{NH}_3^+ \\   \\ \text{C}_6\text{H}_{11} \end{array}$
Part (H)			
(a)	(b)	(c)	(d)
Part (I)			
(a)	(b)	(c)	(d)

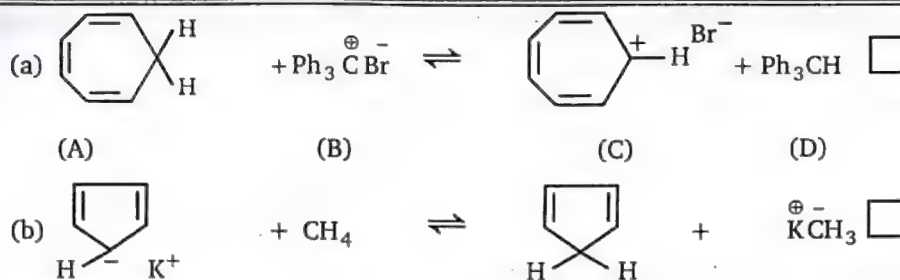
27.



Give the type of hybridization present at each atom.

- (i) N — ..... (ii)  $\text{C}_1$  — ..... (iii)  $\text{C}_2$  — .....  
 (iv)  $\text{O}_1$  — ..... (v)  $\text{CH}_2$  — ..... (vi)  $\text{C}_3$  — .....

28. Predict the direction of the following equilibrium. Write your answer in the box given below.



29. Match the column I and II. (Matrix)

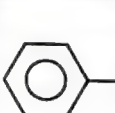
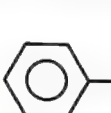
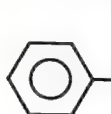
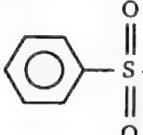
Column (I)		Column (II)	
(a)	NaHCO <sub>3</sub> will react with	(p)	 Squaric acid
(b)	Na will react with	(q)	
(c)	NaOH will react with	(r)	
(d)	NaNH <sub>2</sub> will react with	(s)	

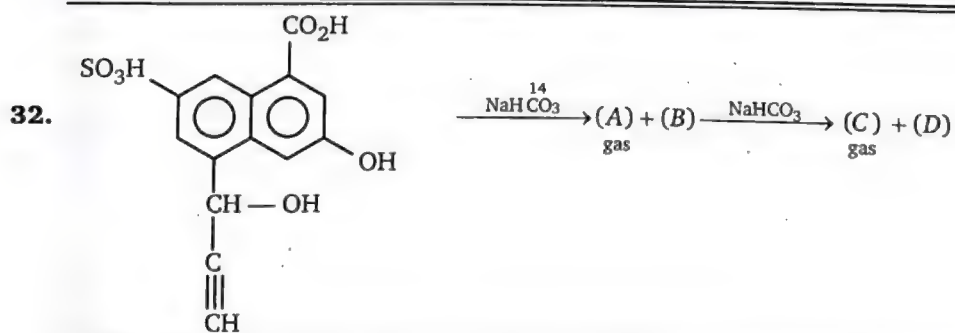
30. Match the column I and II.

Column (I)		Column (II)	
Acid		pK <sub>a</sub>	
(a)	CH <sub>3</sub> —CO <sub>2</sub> H	(p)	5.69
(b)	(CH <sub>3</sub> ) <sub>3</sub> N <sup>⊕</sup> CH <sub>2</sub> CO <sub>2</sub> H	(q)	4.27
(c)	(CH <sub>3</sub> ) <sub>3</sub> N <sup>⊕</sup> (CH <sub>2</sub> ) <sub>4</sub> CO <sub>2</sub> H	(r)	1.83
(d)	<sup>⊖</sup> O <sub>2</sub> C—CH <sub>2</sub> —CO <sub>2</sub> H	(s)	4.80



31. Match the column I and II.

Column (I)		Column (II)	
(a)	 $\text{C}^{14}\text{O}-\text{O}-\text{H} + \text{NaHCO}_3 \rightarrow$	(p)	$\text{NH}_3$
(b)	 $\text{C}-\text{O}-\text{H} + \text{NaHCO}_3 \xrightarrow{^{14}\text{C}}$	(q)	$^{14}\text{CO}_2$
(c)	 $\text{C}-\text{O}-\text{H} + \text{Na} \rightarrow$	(r)	$\text{CO}_2$
(d)	 $\text{S}-\text{O}-\text{H} + \text{NaNH}_2 \rightarrow$	(s)	$\text{H}_2$



Sum of molecular mass of gas (A + C) is :

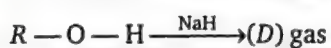
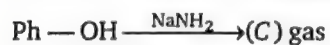
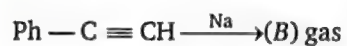
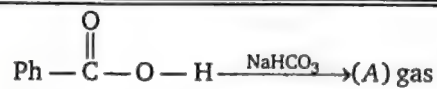
(a) 88

(b) 90

(c) 92

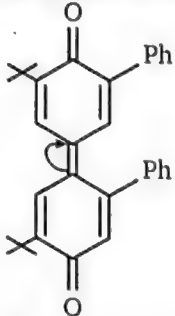
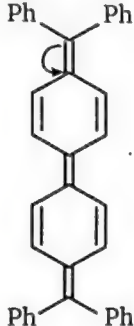
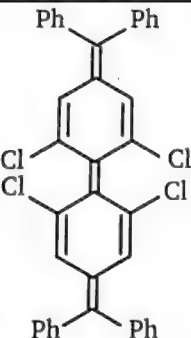
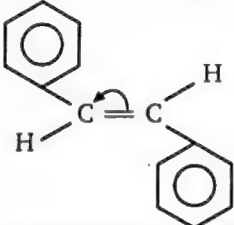
(d) 40

33.

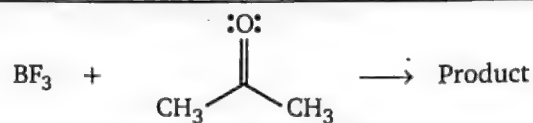


Sum of molecular mass of gas A + B + C + D is :

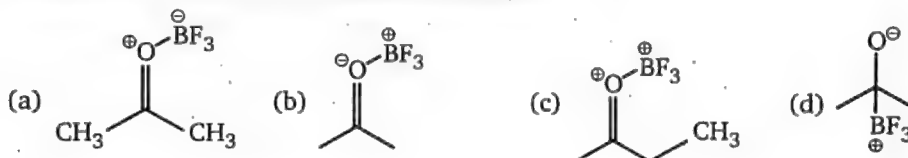
34. Match the column I and II.

Column (I)		Column (II)	
	Molecule		Rotational free energy barrier
(a)		(p)	180 kJ/mol
(b)		(q)	88.3 kJ/mol
(c)		(r)	21 kJ/mol
(d)		(s)	Negative barrier

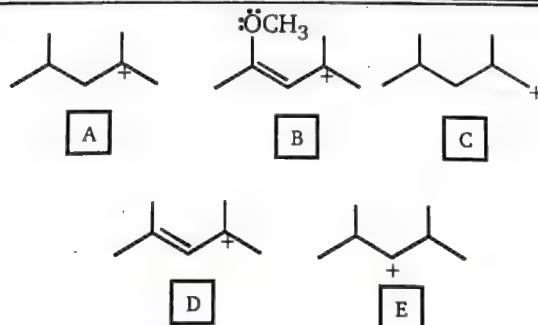
35. Consider the following reaction of boron trifluoride ( $\text{BF}_3$ ) and acetone :



- A. What is the critical HOMO (nucleophile) of this reaction ?  
 (a) non-bonding orbital on boron (b)  $\sigma$ -orbital of acetone  
 (c)  $\pi$ -orbital of acetone (d) non-bonding electron pair orbital on oxygen
- B. What is the critical LUMO (electrophile) of the reaction ?  
 (a)  $p$ -orbital of  $\text{BF}_3$  (b)  $\sigma$ -orbital of  $\text{BF}_3$   
 (c)  $\pi^*$  orbital of acetone (d) non-bonding electron pair orbital on oxygen
- C. Which of the following is the correct product of this reaction ?  
 (Lone electron pairs are not shown explicitly).

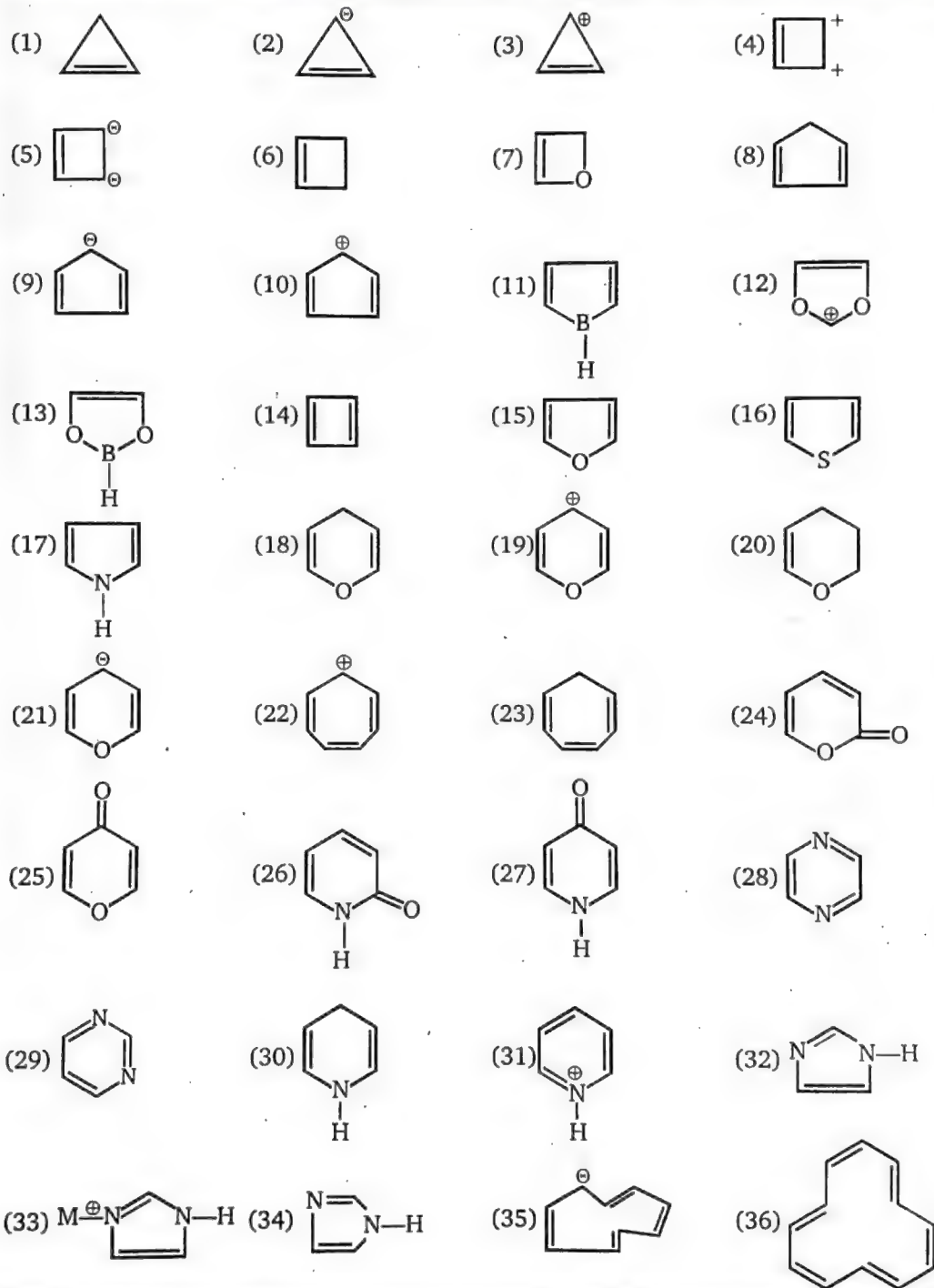


36. Rank the following carbocations according to stability (1 = most stable, 5 = least stable).

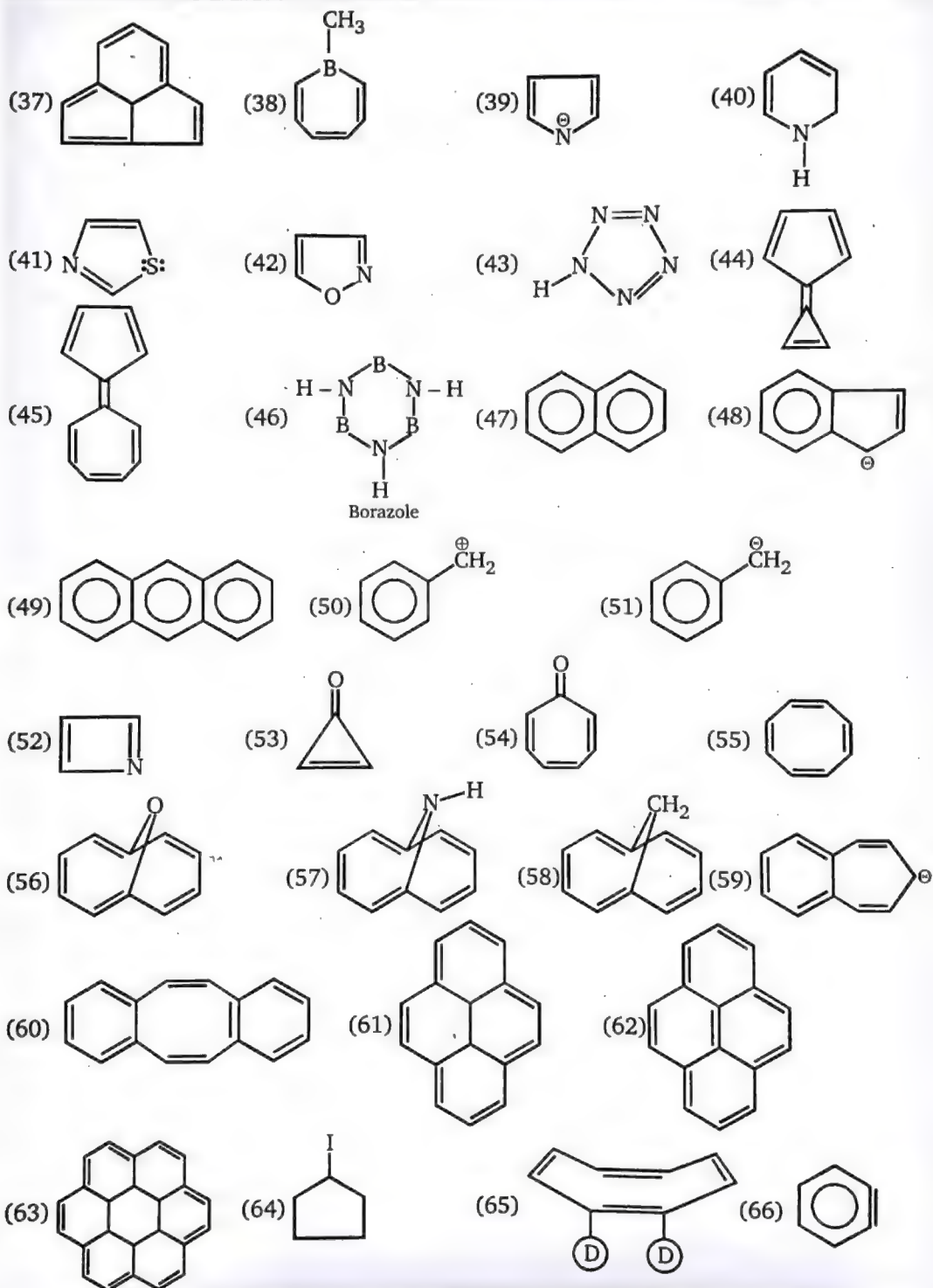


Put the answer in the boxes.

37. Among the given molecules, identify aromatic, anti-aromatic and non-aromatic molecules.

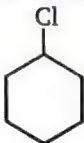
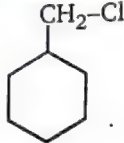






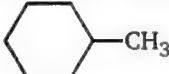
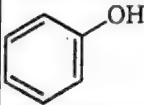
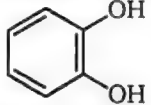
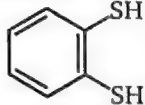




38. Among the given pairs, which is more reactive towards  $\text{AgNO}_3$  (or) toward hydrolysis.

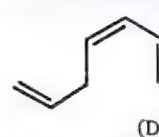
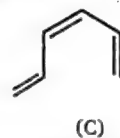
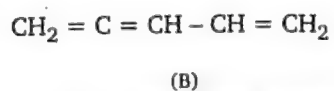
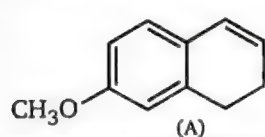
	Compound (A)	Compound (B)	Put the Answer here
1.			
2.			
3.			—
4.			
5.			
6.	$\text{CH}_3 - \text{O} - \text{CH}_2 - \text{Cl}$	$\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{Cl}$	
7.			
8.			
9.			

10.			
-----	---	--	--

39. Put the answer in boxes given as directed.

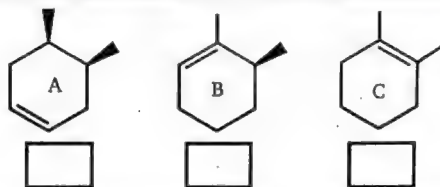
S.No.	Property	Molecules	Correct Answer	Name of force responsible for the property
A.	highest boiling point	$\text{NCl}_3$ $\text{ClNH}_2$ $\text{NH}_4\text{Cl}$ $\text{NH}_3$		
B.	highest boiling point	  		
C.	most soluble in water	  		
D.	highest solubility in benzene	 		

40. Circle any conjugated portions of these molecules.

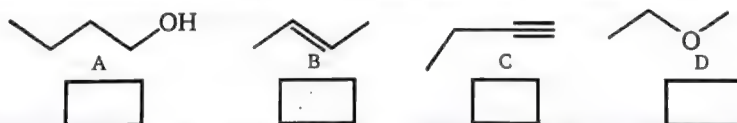


41. Arrange in the order as directed -

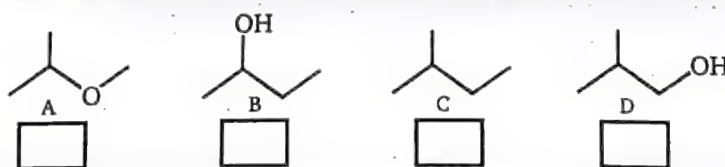
A. The given alkenes in the order of their stability (1- most stable, 3-least stable).



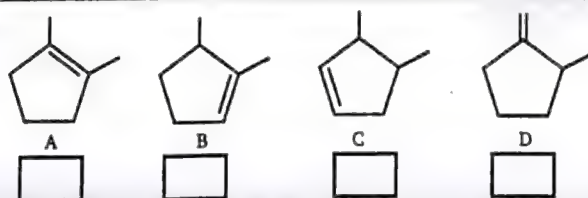
B. Arrange the following in the order of their acidic strength (1-most acidic, 4-least acidic)



C. Arrange the following molecules in order of expected boiling point. (1=highest bpt ; 4=lowest bpt.)



D. Arrange the following alkenes in order of their stability. (1 = most stable ; 5 = least stable).



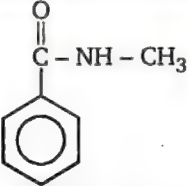
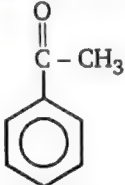
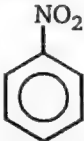
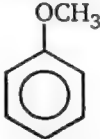
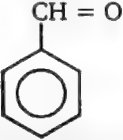
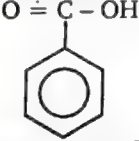
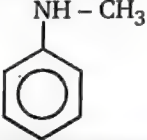
## 42. Match the column. (Matrix)

Column (I)		Column (II)	
Compounds		Number of Benzylic hydrogen	
(a)		(p)	2
(b)		(q)	3
(c)		(r)	4
(d)		(s)	5

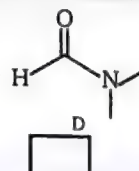
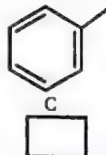
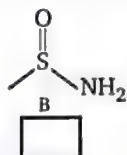
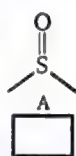
## 43. Identify (+M) mesomeric &amp; (-M) group of following.

	+M	-M	-I	+I

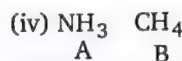
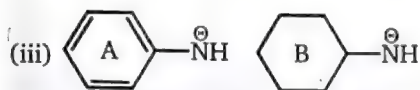
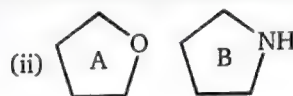
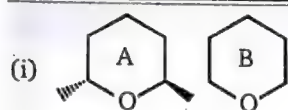


44. Identify the following solvents as polar protic (PP), polar aprotic (PA), non-polar protic (NPP) or non-polar aprotic (NPA).



45. Identify the stronger nucleophile in each pair.



46. Encircle the molecule as directed :

(a) Which has higher boiling point :  $\text{HBr}$  or  $\text{HCl}$

(b) Which has a higher boiling point :  $\text{CH}_3 - \text{CH}_2 - \text{OH}$  or  $\text{CH}_3 - \text{CH} = \text{O}$

(c) Which is more miscible with methanol ( $\text{CH}_3\text{OH}$ ) :  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$

or  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$

(d) Which has a higher melting point :  $\text{CH}_4$  or  $\text{CH}_3 - \text{CH}_2 - \text{CH}_3$

(e) Which has a higher boiling point :  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$  or  $\text{CH}_3 - \underset{\text{CH}_3}{\overset{\text{CH}_3}{\text{C}}} - \text{CH}_2 - \text{CH}_3$

47. Encircle the molecule as directed :

(a) Which is more stable :  $\text{BH}_3$  or  $\text{BF}_3$

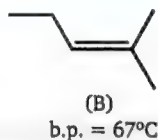
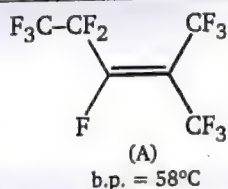
(b) Which is a stronger base :  $\text{HO}^-$  or  $\text{H}_2\text{O}$

(c) Which is a stronger base :  $\text{HO}^-$  or  $\text{HS}^-$

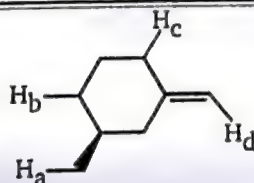
(d) Which is a stronger acid :  $\text{HCl}$  or  $\text{HI}$

(e) Which is a stronger acid :  $\text{HOCl}$  or  $\text{HCl}$

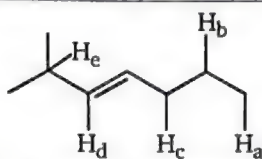
48. Explain why **A** has lower boiling point than **B** ?



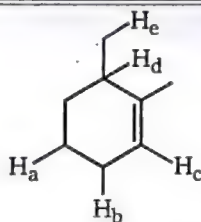
49. Arrange the protons shown in the decreasing order of their approximate bond energies.



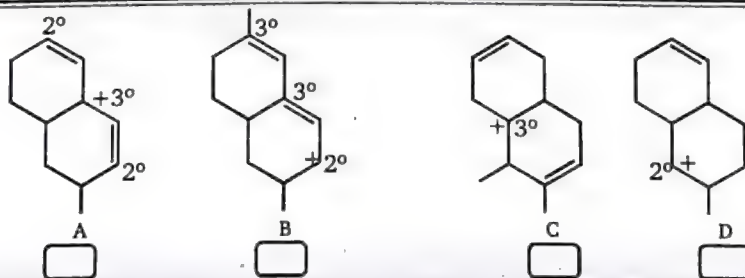
50. Consider the H-atoms in the molecule given below and answer the following.



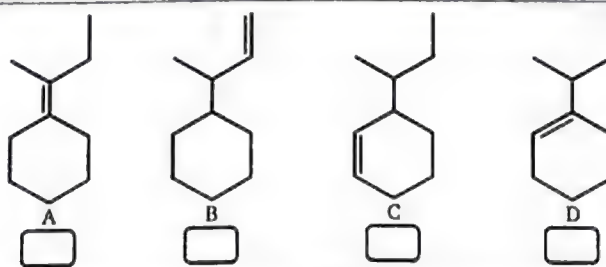
- (A) Identify the type ( $1^\circ$ ,  $2^\circ$  or  $3^\circ$  alkyl, vinyl, allyl etc.) of these H-atoms.  
(B) Arrange them in the decreasing order of their ease of abstraction (easiest first)
51. Consider the molecule shown below and answer with respect to  $H_a \rightarrow H_e$



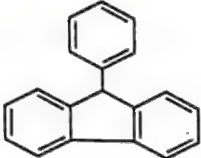
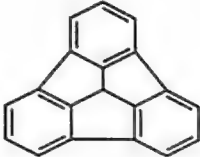
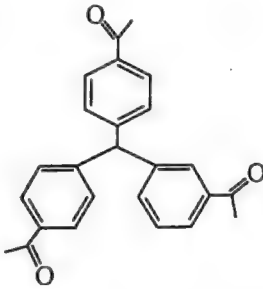
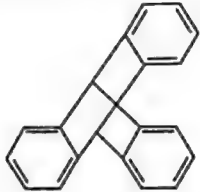
- (A) Identify the type of H-atom ( $1^\circ$ ,  $2^\circ$ ,  $3^\circ$  alkyl, vinyl or allyl)  
(B) Arrange them in decreasing order of their bond energy.
52. Rank the following carbocations in order of stability (1 = most stable).



53. Rank the following alkenes according to energy (1 = lowest energy).

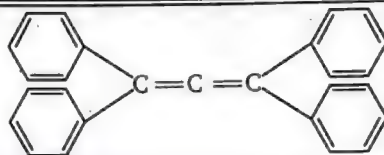


54. Match the column:

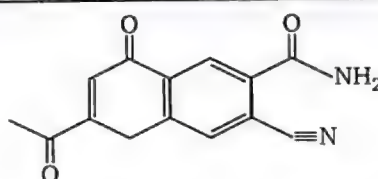
Column (I)		Column (II)	
(Compounds)		(Double bond equivalent value)	
(a)		(p)	11
(b)		(q)	12
(c)		(r)	13
(d)		(s)	14
		(t)	15

## SUBJECTIVE PROBLEMS

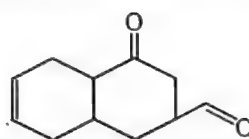
1. How many 2° carbon in the following ?



2. Find out the double bond equivalent (DBE) value of the given following compound:



3. Total number of functional groups present in the given following compound :

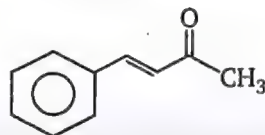


4. Total number of  $\alpha$ -hydrogen in the given following compound is:

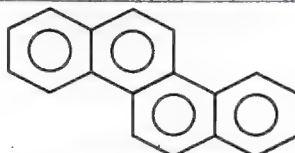




5. How many carbon atom present in the parent chain in the given following compound?

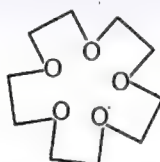


6. Total number of DBE value in :



7. How many isomers of  $C_4H_{10}O$  reacts with Na metal to evolve  $H_2$  gas ? (excluding stereoisomer)

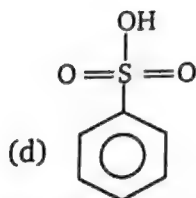
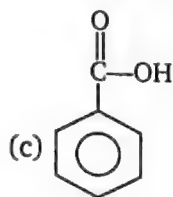
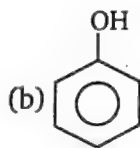
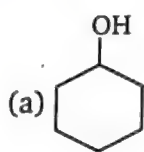
8.



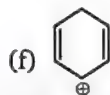
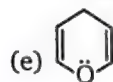
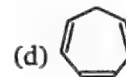
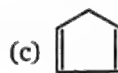
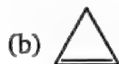
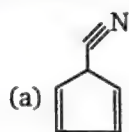
[x]-crown-[y]-ether.

value of  $\frac{x+y}{3} = ?$

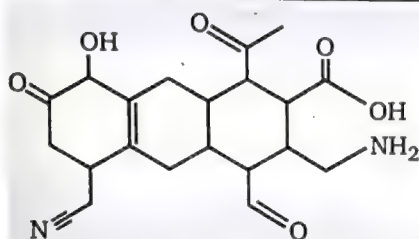
9. Which of the given following compound will react with  $NaHCO_3$  or soluble in  $NaHCO_3$  ?



10. How many compound are stable after deprotonation ?

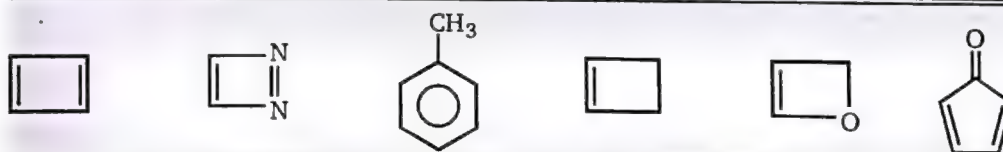


11.



Sum of types of functional group and DBE value for given compound is  $X$  so the value of  $X - 10$  is

12.  $P$  = Number of anti-aromatic compound, so the value of  $x$  is :



$Q$  = Total number of resonating structures of carbonate ion  $[\text{CO}_3^{2-}]$

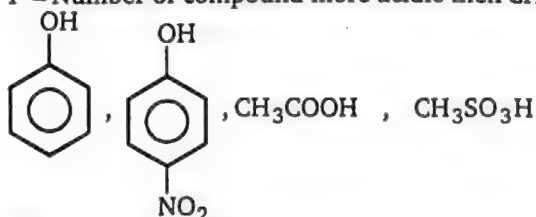


$R$  = Number of  $\alpha$ -hydrogen in given carbocation



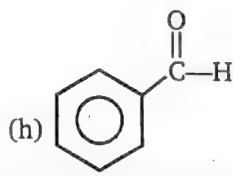
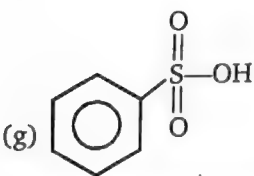
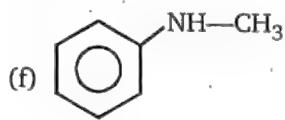
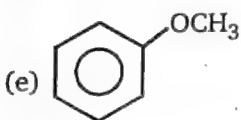
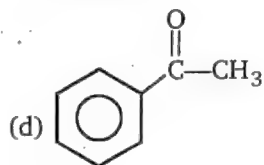
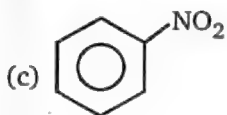
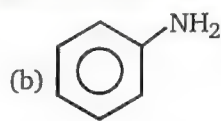
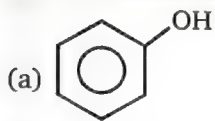
$S$  = Total number of geometrical isomers of  $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH} = \text{CH}_2$

$T$  = Number of compound more acidic than  $\text{CH}_3\text{CH}_2\text{OH}$



Sum of  $(P + Q + R + S + T) - 15$  is :

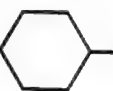
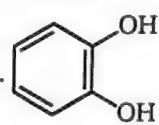
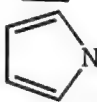
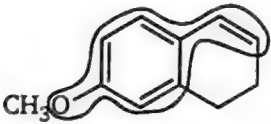
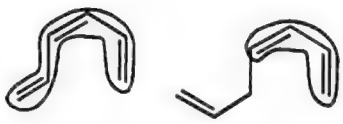
13.  $x$  = number of (+M) group attached with phenyl ring, so the value of  $x$  is.



## ANSWERS — LEVEL 2

1. a-4; b-3; c-2; d-1
2. a-3; b-2; c-1
3. A-b; B-e; C-a; D-b
4. A-a, c, f, g, k, l; B-b, d, h, j; C-e, i
5. A-d; B-a
6.  $C < B < A$
7. a-2, 1, 4, 3; b-1, 2, 3, 4; c-3, 4, 1, 2; d-3, 2, 4, 1
8. a-iv > ii > i > iii; b-iii > iv > i > ii
9. a-4, 2, 3, 1; b-3, 1, 4, 2; c-2, 1, 3, 4; d-2, 3, 4, 1
10. A (i) - d > b > c > a; (ii) - c > a > b > d  
B (i) - c > d > b > a; (ii) - b > d > c > a
11. (a) 3 2 1 4; (b) 2 1 4 3; (c) 3 1 2 4; (d) 3 4 1 2
12. A-c < a < b; B-b < a < c < d; C-d < b < c < a
13. A-c < a < b; B-a < b < c; C-c < b < a; D-d < c < a < b; E-c < a < b; F-a > b > c
14. A-H<sub>c</sub> < H<sub>a</sub> < H<sub>b</sub>; B-H<sub>d</sub> < H<sub>c</sub> < H<sub>b</sub> < H<sub>a</sub>
15. A-1, 3, 4, 6, 7, 8, 9; B-2, 5; C-6; D-3, 4, 6, 7, 9; E-6, 8, 9; F-6; G-7; H-9; I-4, 7
16. A-b; B-a; C-d; D-b; E-a; F-d; G-d; H-a
17.

	(i)	(ii)	(iii)	(iv)	(v)
A	6	4	0	10	2
B	0	7	2	9	6
C	5	1	0	5	1
D	1	3	1	3	4
E	2	3	0	2	2
F	10	0	0	10	0
18. a-q; b-p, r; c-p, s; d-q
19. a-p; b-r; c-s; d-q
20. A-c; B-d
21. A-b; B-b; C-a
22. a-p, s; b-q, r; c-q, s; d-p, s
23. a-p, r, s; b-q, r; c-q, r; d-p, r, s

24. A - b; B - c; C - a; D - c; E - a; F - b; G - d  
 25. A - d; B - a; C - d; D - c  
 26. A - c; B - b; C - b; D - b; E - b; F - a; G - b; H - c; I - b  
 27. i. -  $sp$ ; ii. -  $sp$ ; iii. -  $sp^2$ ; iv. -  $sp^2$ ; v. -  $sp^3$ ; vi. -  $sp^3$   
 28. a - forward      b - backward  
 29. a - p, q, s; b - p, q, r, s; c - p, q, r, s; d - p, q, r, s  
 30. a - s; b - r; c - q; d - p  
 31. a - r; b - q; c - s; d - p  
 32. b  
 33. 65  
 34. a - q; b - r; c - s; d - p  
 35. A - d; B - a; C - a  
 36. A - 3; B - 1; C - 5; D - 2; E - 4  
 37. Aromatic— 3, 4, 5, 9, 12, 13, 15, 16, 17, 19, 22, 24, 25, 26, 27, 28, 29, 31, 32, 33, 34, 35, 37, 38, 39, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 53, 54, 56, 57, 58, 61, 62, 63, 66  
 Non-aromatic— 1, 6, 7, 8, 18, 20, 23, 30, 40, 55, 64, 65  
 Anti-aromatic— 2, 10, 11, 14, 21, 36, 52, 59, 60  
 38. 1 - B; 2 - A; 3 - B; 4 - A; 5 - A; 6 - A; 7 - B; 8 - B; 9 - A; 10 - A  
 39. A.  $\text{NH}_4\text{Cl}$ , cation-anion interactoin  
 B.   $\text{CH}_3$ , van der Waals' forces  
 C. , H-bonding (Also dipole-dipole)  
 D.   $\text{NH}_2$ , Aromatic stacking  
 40.   $\text{CH}_2 = \text{C} = \text{CH} - \text{CH} = \text{CH}_2$    
 41. A. A - 3, B - 2, C - 1,      B. A - 1, B - 3, C - 2, D - 4  
 C. A - 3, B - 1, C - 4, D - 2      D. A - 1, B - 2, C - 3, D - 4  
 42. a - s; b - r; c - q; d - p



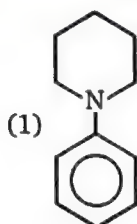
43.

+M

-M

-I

+I

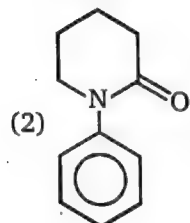


✓

x

✓

x

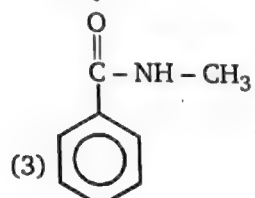


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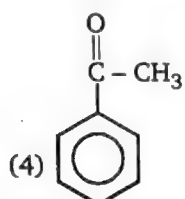


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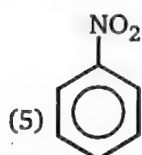


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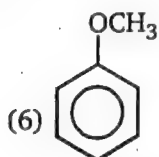


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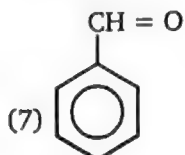


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x

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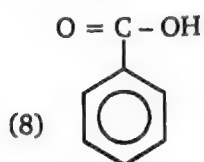


x

✓

✓

x

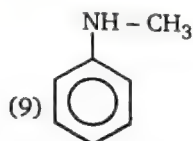


x

✓

✓

x



✓

×

✓

×

44. A - PA; B - PP; C - NPA; D - PA

45. (i) B, (ii) B, (iii) B, (iv) A

46. (a)  $\text{HBr}$ ; (b)  $\text{CH}_3 - \text{CH}_2 - \text{OH}$ ; (c)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$ ;(d)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_3$ ; (e)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$ 47. (a)  $\text{BF}_3$ ; (b)  $\text{HO}^-$ ; (c)  $\text{HO}^-$ ; (d)  $\text{HI}$ ; (e)  $\text{HOCl}$ 

48. In A, highly electronegative F-atoms are present at the periphery. In liquid term these F-atoms will repel each other due to partial negative charge and thus A will have lower b.pt.

49.  $H_d > H_a > H_b > H_c$ 50. A-  $H_a = 1^\circ$  alkyl;  $H_b = 2^\circ$  alkyl;  $H_c = 2^\circ$  allyl;  $H_d = \text{vinyl}$ ;  $H_e = 3^\circ$  allylB- Easiest to abstract:  $H_e > H_c > H_b > H_a > H_d$  Hardest to abstract51. A-  $H_a = 2^\circ$  alkyl;  $H_b = 2^\circ$  allyl;  $H_c = \text{vinyl}$ ;  $H_d = 3^\circ$  allyl;  $H_e = 1^\circ$  alkylB-  $H_c > H_e > H_a > H_b > H_d$ 

52. A-2; B-1; C-3; D-4

53. A-1; B-4; C-3; D-2

54. a-r; b-t; c-t; d-s

**Subjective Problems**

1. 21    2. 11    3. 3    4. 6    5. 4    6. 13    7. 4    8. 7

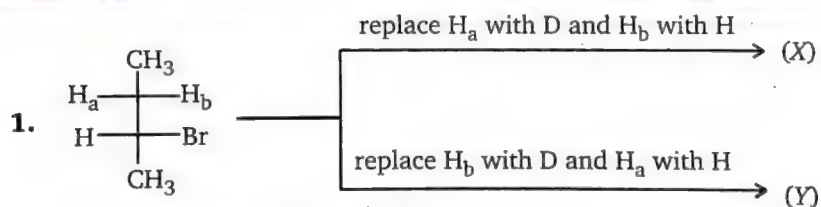
9. 2 (c, d)    10. 3 (a, c, f)    11. 7

12.  $P = 3, Q = 3, R = 7, S = 2, T = 4 = 19 - 15 = 4$     13. 4

# 2

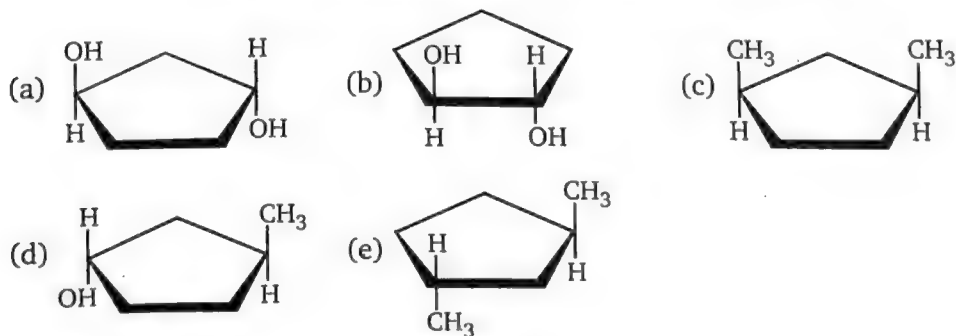
## ISOMERISM (Structural & Stereoisomerism)

### LEVEL-1

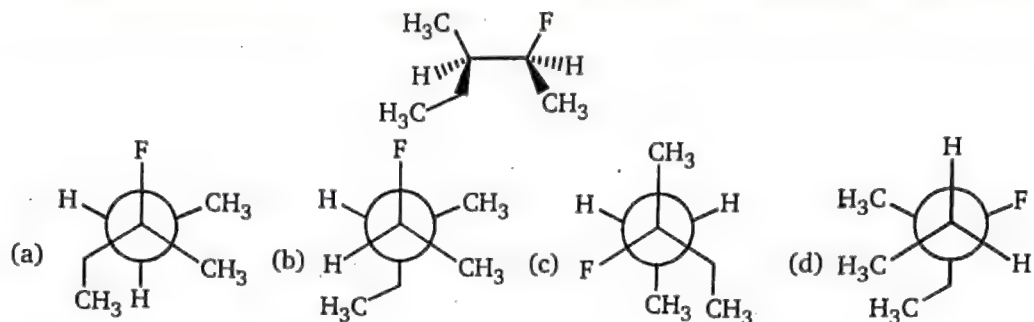


Relation between (X) and (Y) is :

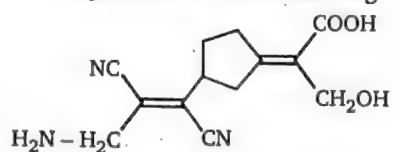
- (a) enantiomers (b) diastereomers  
(c) *E* and *Z* isomer (d) constitutional isomer
2. Which of the following cyclopentane derivative is optically **inactive** ?



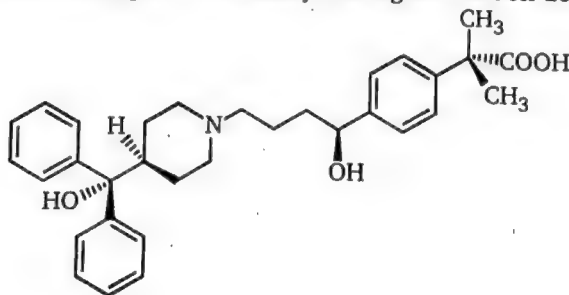
3. Which is the most stable conformer along the 2, 3 C - C bond axis of the compound ?



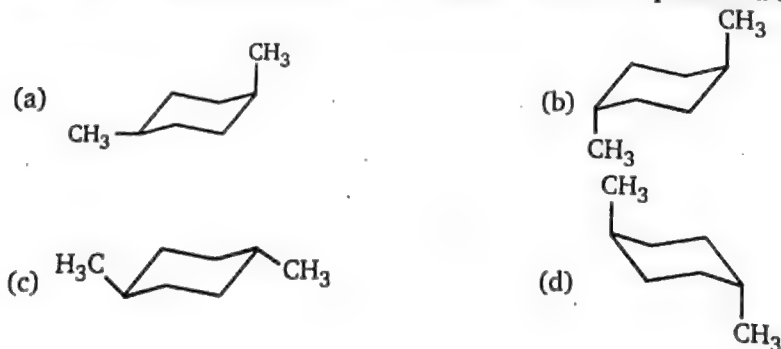
4. Assign double bond configurations to the following :



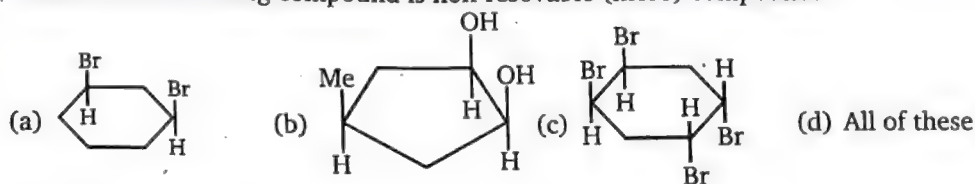
- (a) E (b) Z (c) E, E (d) Z, Z
5. Allegra, a common prescription drug with the structure shown below, is given for the treatment of seasonal allergies. How many stereogenic carbon does Allegra possess ?



- (a) 1 (b) 2 (c) 3 (d) 4
6. How many meso isomers of  $C_4H_8Cl_2$  will be ?
- (a) 0 (b) 1 (c) 2 (d) 3
7. The stable form of *trans*-1, 4-dimethylcyclohexane is represented as:



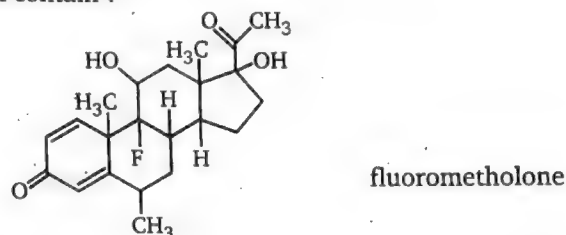
8. Which of the following compound is non-resolvable (meso) compounds ?



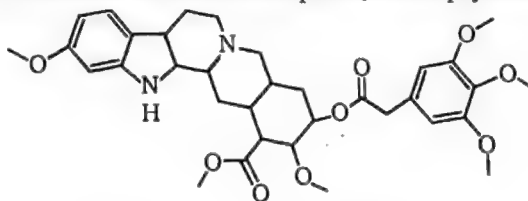
9.  $\text{HO}-\underset{(2)}{\text{CH}_2}-\underset{(3)}{\text{CH}_2}-\text{F}$

Which conformer of above compound is most stable across  $\text{C}_2-\text{C}_3$ ?

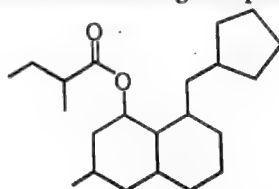
- (a) staggered (b) eclipsed (partially)  
(c) gauche (d) fully eclipsed
10. The following molecule is fluorometholone, a steroidal anti-inflammatory agent. How many stereogenic centers does it contain ?



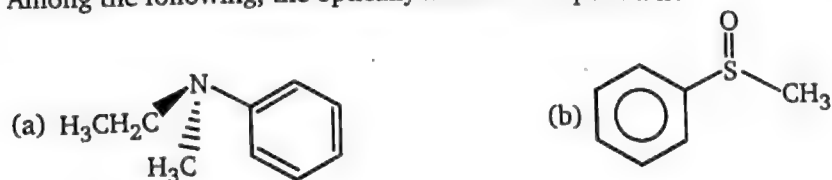
- (a) 5 (b) 6 (c) 7 (d) 8
11. How many chiral carbons are there in Reserpine (an antipsychotic drug) ?



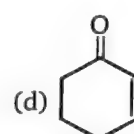
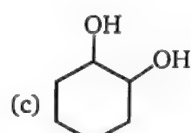
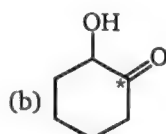
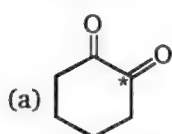
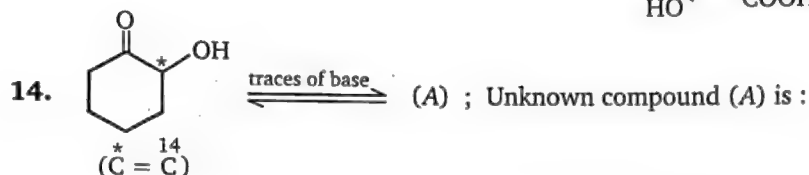
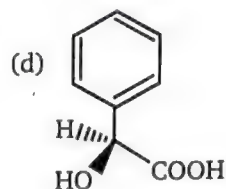
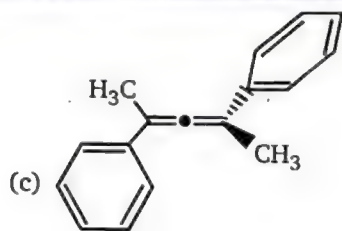
- (a) 9 (b) 8 (c) 7 (d) 6
12. How many chiral centers are in the following compound ?



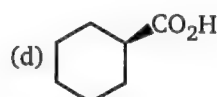
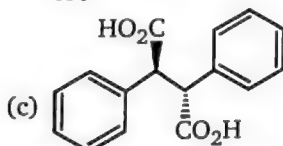
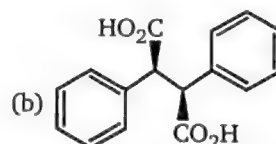
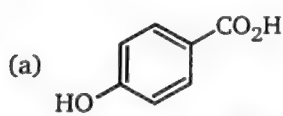
- (a) 4 (b) 5 (c) 6 (d) 7
13. Among the following, the optically inactive compound is:



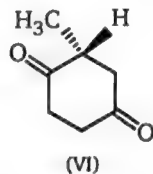
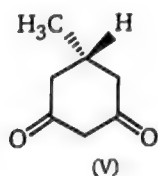
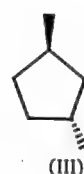
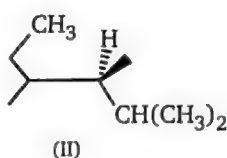
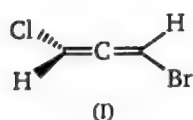




15. Which of the following compounds might be useful to the chemist trying to increase the optical purity of the (d) sample ?



16. Which of the following molecules is (are) chiral ?



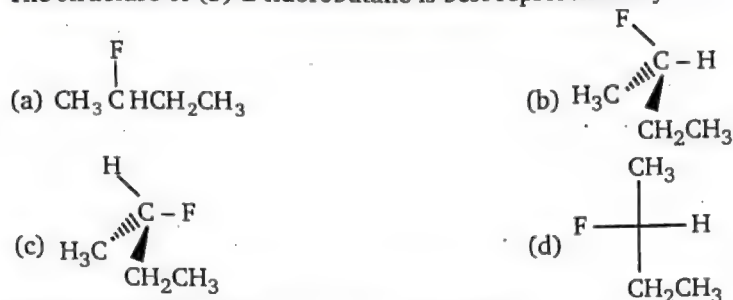
(a) I and II

(b) III and IV

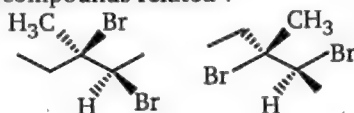
(c) II, IV and VI

(d) I, II, III and VI

17. The structure of (S)-2-fluorobutane is best represented by :

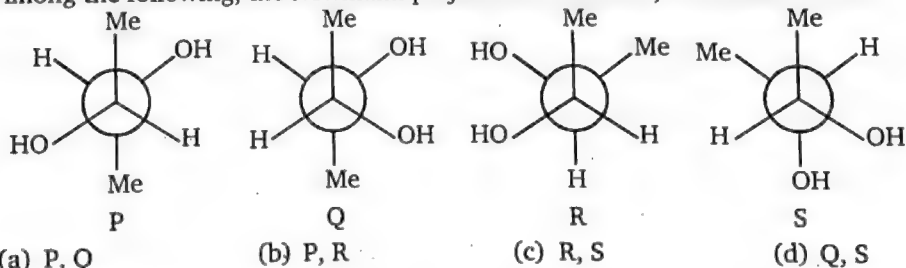


18. How are the following compounds related ?

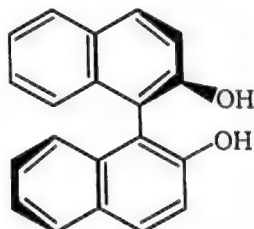


- (a) Diastereomers  
(b) Enantiomers  
(c) Meso compounds  
(d) Identical
19. Which one of the following is chiral ?
- (a) 1, 1-Dibromo-1-chloropropane  
(b) 1, 3-Dibromo-1-chloropropane  
(c) 1, 1-Dibromo-3-chloropropane  
(d) 1, 3-Dibromo-2-chloropropane

20. Among the following, the Newmann projections of meso-2, 3-butanediol are :

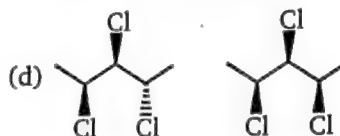
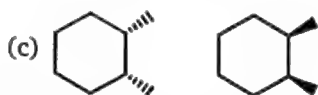
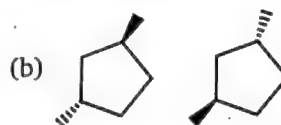
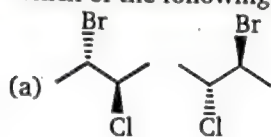


21. The binaphthol (**Bnp**) is:

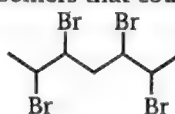


- (a) an optically active compound having chiral centre  
(b) an optically inactive compound  
(c) a meso compound  
(d) an optically active compound without having chiral centre

22. Which of the following pairs of compounds is a pair of enantiomers ?

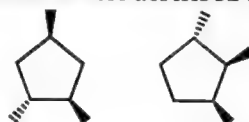


23. The maximum number of stereoisomers that could exist for the compound below ?



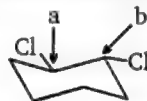
- (a) 6 (b) 8 (c) 10 (d) 16

24. The following pair of compounds is best described as :



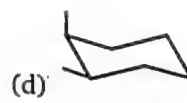
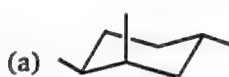
- (a) identical (b) diastereomers  
(c) enantiomers (d) none of the above

25. Determine the absolute configurations of the labeled carbons (a and b):



- (a)  $a = R ; b = R$  (b)  $a = R ; b = S$   
(c)  $a = S ; b = R$  (d)  $a = S ; b = S$

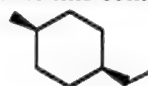
26. Which of the structures (a – d) will be produced if a “ring flip” occurs in the following compound in chair form ?



27. Which of the following compounds is most stable ?

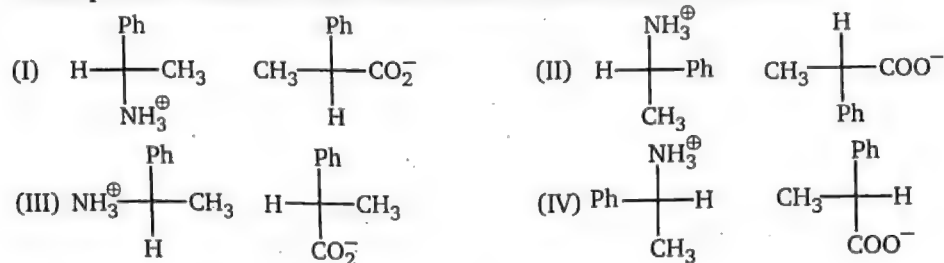


28. Which is the most stable chair form of this compound ?





29. Which pairs of the salts would have identical solubilities in methanol?



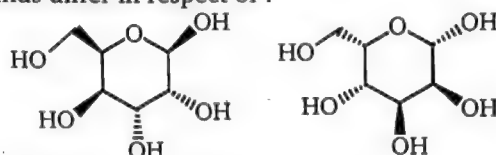
(a) I & IV

(b) I & III

(c) I & II

(d) II & IV

30. The following compounds differ in respect of:



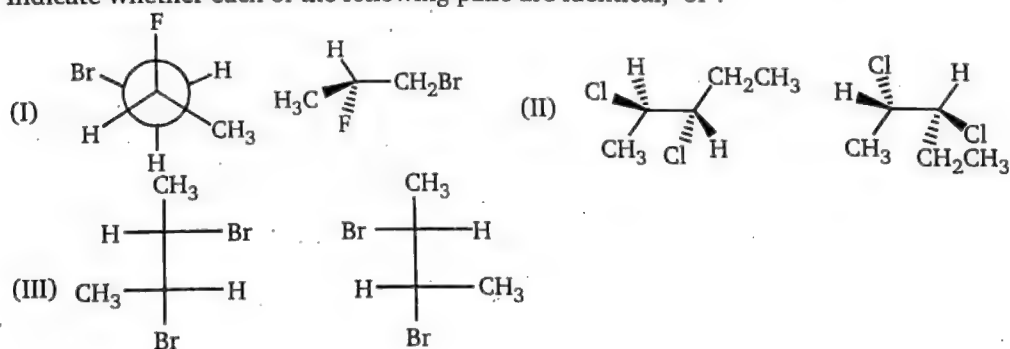
(a) their chemical and physical properties

(b) nothing

(c) the direction in which they rotate plane of polarized light

(d) their interactions with molecules

31. Indicate whether each of the following pairs are identical, or?



I

II

III

(a) enantiomers

diastereomers

enantiomers

(b) identical

enantiomers

enantiomers

(c) enantiomers

diastereomers

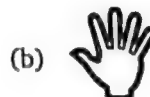
identical

(d) enantiomers

identical

identical

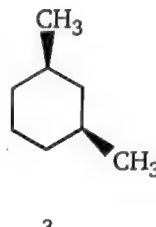
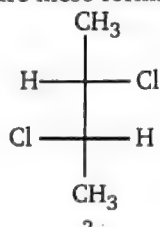
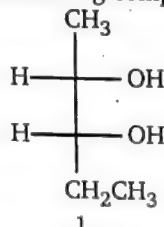
32. Which of the following is achiral?





(d) a molecule of 3-methylheptane

33. Which of the following compounds are meso forms ?



(a) 1 only

(b) 3 only

(c) 1 and 2

(d) 2 and 3

34. The separation of a racemic mixture into pure enantiomers is termed as :

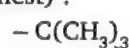
(a) Racemization

(b) Isomerization

(c) Resolution

(d) Equilibration

35. Rank of the following groups in order of R, S precedence (IV is highest) :



I

II

III

IV

I

II

III

IV

(a) 3

2

4

1

(b) 1

4

2

3

(c) 3

4

1

2

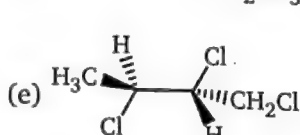
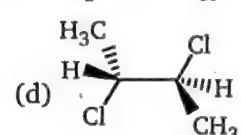
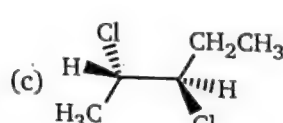
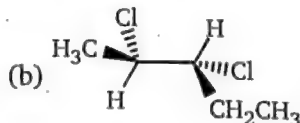
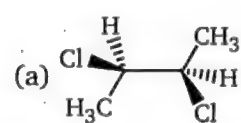
(d) 3

4

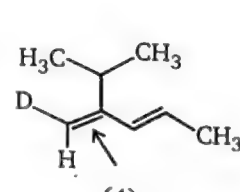
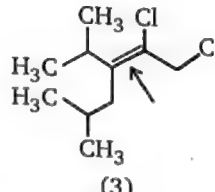
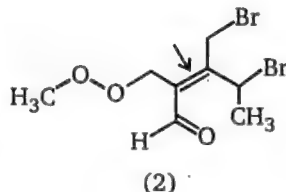
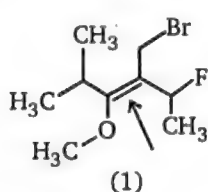
2

1

36. Which of the following is a meso compound ?



37. Among the following structures, select E isomers (arrows indicate the bonds to be considered) ?



(a) 1 and 2

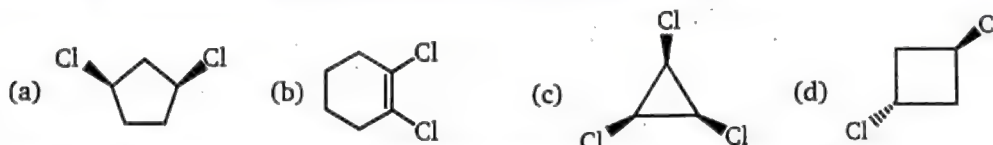
(b) 1 and 3

(c) 1 and 4

(d) 2 and 3



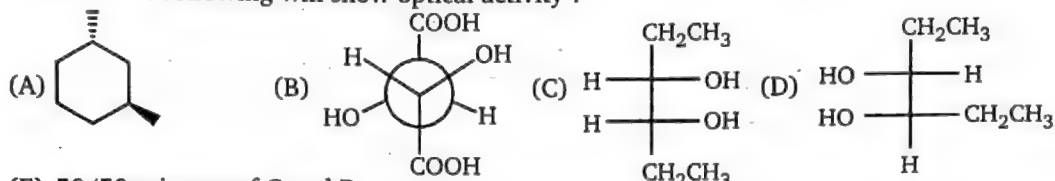
38. Which of the following compounds has a zero dipole moment ?



39. On Pluto, where everything is frozen, astronauts discovered two forms of butane gauche and anti. Assuming that there are no rotations around single bonds, which statement about the two forms is correct ?

- (a) They are enantiomers  
 (b) They are diastereoisomers  
 (c) They are meso compounds  
 (d) The gauche form has two stereogenic centers, and the anti has only one

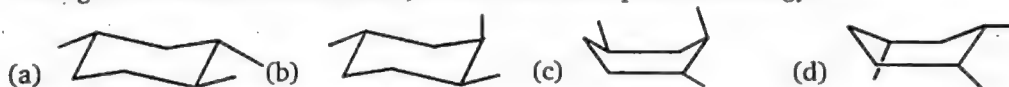
40. Which of the following will show optical activity ?



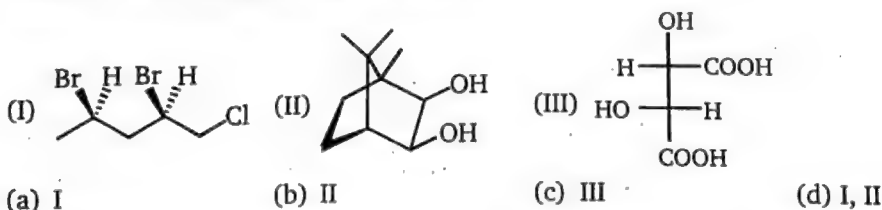
(E) 50/50 mixture of C and D

- (a) A, D and E (b) A and E only (c) B, C and D (d) All except C

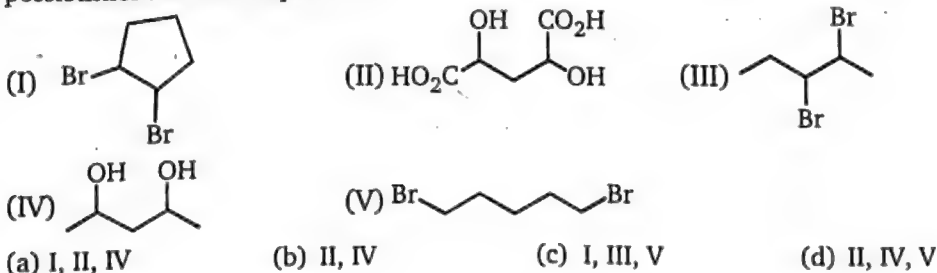
41. Among the structure shown below, which has lowest potential energy ?



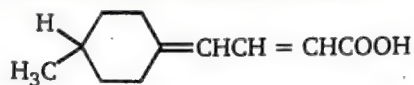
42. Which of the following molecules is/are chiral ?



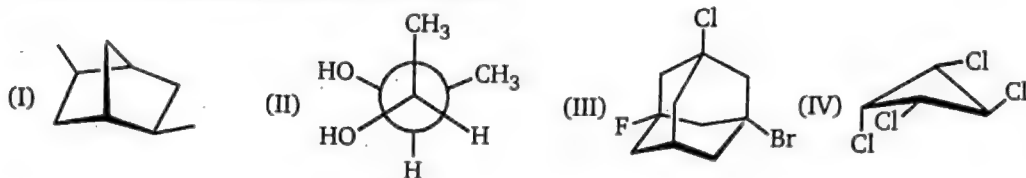
43. A compound was synthesized by a student, but its structure was not identified. However, his wonderfully helpful instructor told him that it was a meso compound with 5 carbons and 2 stereogenic centers. Which of the following structures should the student consider as possibilities for his compound ?



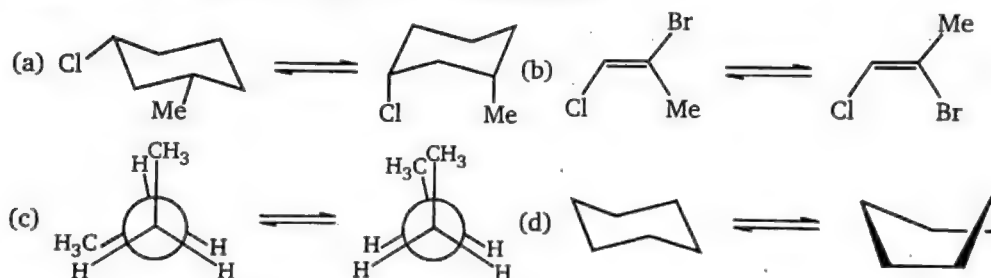
44. How many isomers are possible for the following molecule ?



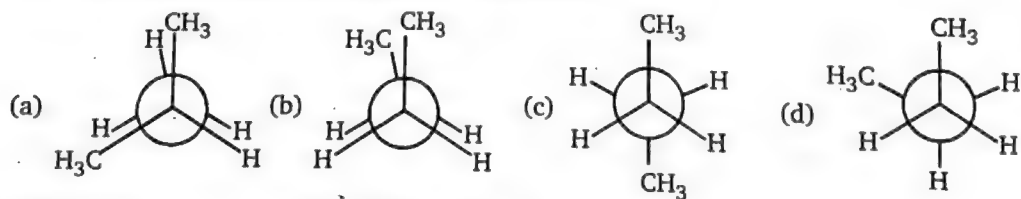
- (a) 1 (b) 2 (c) 3 (d) 4
45. Which of the following molecules are chiral ?



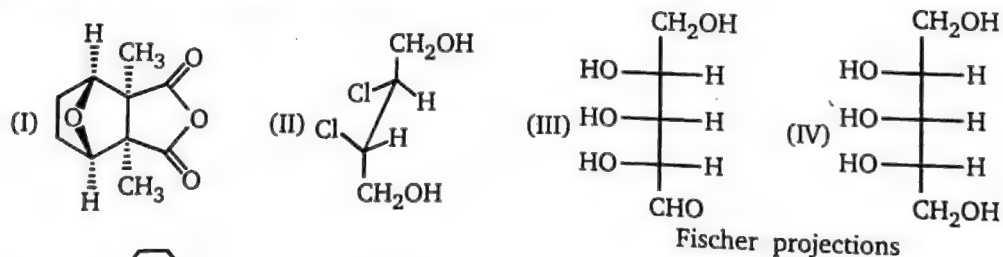
- (a) I, II, III and IV (b) II, III and IV (c) II and IV (d) I and II
46. Which equilibrium is not rapid at room temperature ?



47. Which is the lowest energy conformation of butane ?

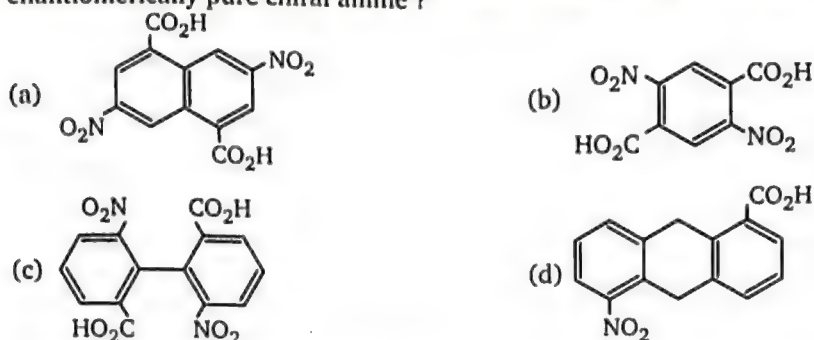


48. Which of the structures given below are chiral ?

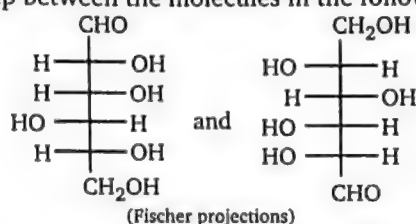


- (a) I, II, III (b) II, III, V (c) II, III (d) I, II

49. Which of the following carboxylic acids could be resolved by reaction with an enantiomerically pure chiral amine?

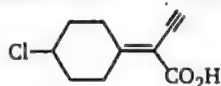


50. What is the relationship between the molecules in the following pairs?



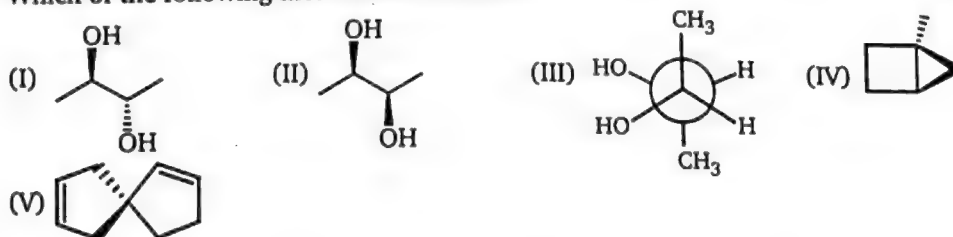
- (a) enantiomers      (b) diastereomers      (c) identical      (d) structural isomers

51. What are the correct designations for the structure below?



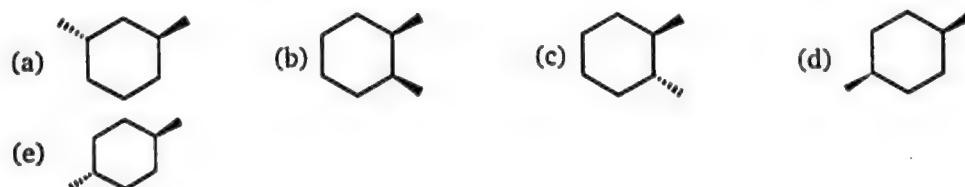
- (a) E, E      (b) Z, E  
(c) E, Z      (d) No geometrical isomers are possible

52. Which of the following molecules are chiral?

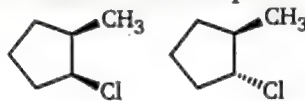


- (a) I and III      (b) I and V      (c) II and III      (d) II, III, IV

53. Which one of the following isomeric structures has the lowest energy?

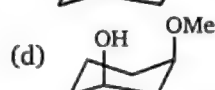
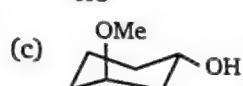
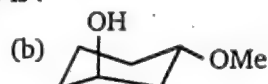


54. The following compounds are identical with respect to :

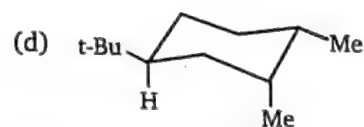
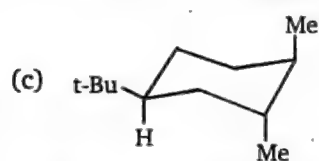
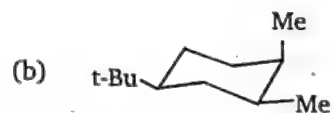
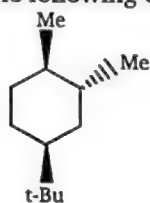


- (a) molecular composition  
(b) boiling point  
(c) melting point  
(d) IUPAC name

55. Among the following, the most stable isomer is :

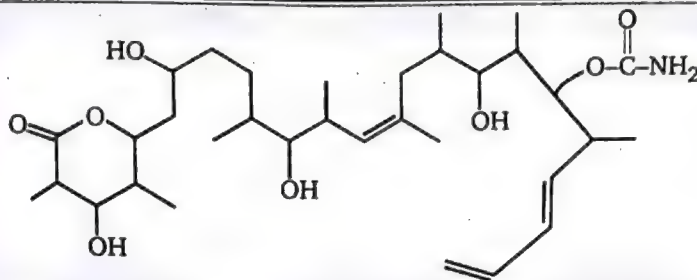


56. The most stable conformation of the following compound is :



57. Which of the following molecules have non-zero dipole moments ?  
 (I) gauche conformation of 1, 2-dibromoethane  
 (II) anti conformation of 1, 2-dibromoethane  
 (III) *trans*-1, 4-dibromocyclohexane  
 (IV) *cis*-1, 4-dibromocyclohexane  
 (V) tetrabromomethane  
 (VI) 1, 1-dibromocyclohexane
- (a) I and II  
(b) I and IV  
(c) II and V  
(d) I, IV and VI

58. What is the maximum number of stereoisomers possible for discodermolide ?



- (a)  $2^{14}$  (b)  $2^{15}$  (c)  $2^{16}$  (d)  $2^{17}$

59. An aqueous solution containing compounds *A* and *B* shows optical activity. *A* and *B* are stereoisomers. Which of the following possibilities cannot be correct ?

- (a) *A* has two chiral centers, but *B* does not have any because it has a symmetry plane  
 (b) *A* and *B* are enantiomers  
 (c) *A* and *B* are diastereomers  
 (d) *A* and *B* are not present in equal amounts

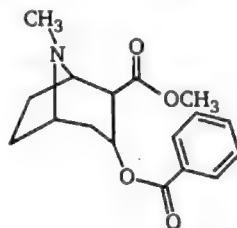
60. Which of the following structures represents the lowest-energy form of (1*S*, 2*S*, 4*R*)-trimethyl-cyclohexane ?



61. Which one of the following is a diastereomer of (R)-4-bromo-*cis*-2-hexene ?

- (a) (S)-4-bromo-*cis*-2-hexene  
 (b) (S)-5-bromo-*trans*-2-hexene  
 (c) (R)-4-bromo-*trans*-2-hexene  
 (d) (R)-5-bromo-*trans*-2-hexene

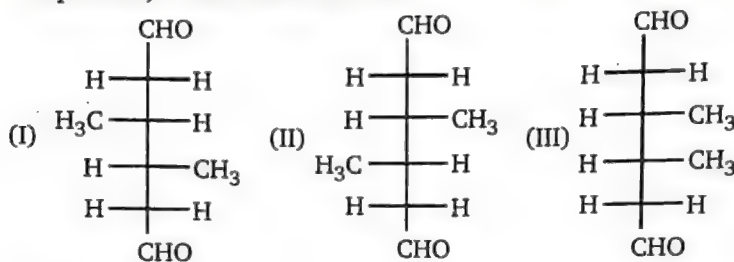
62. The structural formula of cocaine is shown below. How many stereogenic carbon atoms are there in this molecule ?



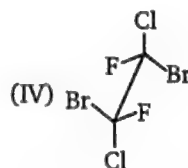
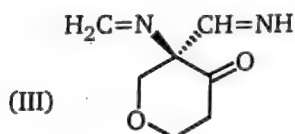
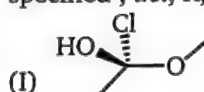
- (a) 1 (b) 2 (c) 3 (d) 4



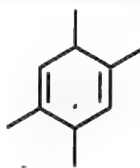
63. Which of the following statements best describes the stereochemical relationships of compound I, II and III shown below ?



- (a) All compounds are chiral  
 (b) None of the compounds is chiral  
 (c) I and II are meso compounds  
 (d) I and II are diastereomers, and III is a meso compound  
 (e) I and II are chiral
64. What is the absolute configuration of the following molecules ? (NS = the molecule has no center) Note : For the purpose of this question only, the order of stereocenters is not specified ; i.e., R, S = S, R.

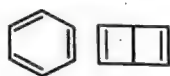


- |     | I | II   | III | IV   |
|-----|---|------|-----|------|
| (a) | R | R, S | R   | NS   |
| (b) | R | R, R | S   | R, R |
| (c) | R | R, S | NS  | NS   |
| (d) | R | R, S | R   | R, S |
65. The number of all the possible stereoisomers formed by the given compound is :

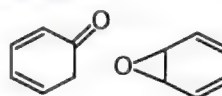


- (a) 2  
 (b) 3  
 (c) 32  
 (d) 64

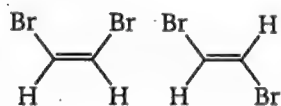
66. The relationship among the following pairs of isomers is:



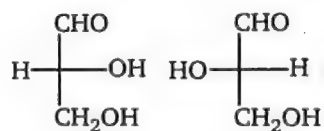
(I)



(II)



(III)



(IV)

<b>I</b>	A: Constitutional
<b>II</b>	B: Configurational
<b>III</b>	C: Conformational
<b>IV</b>	D: Optical

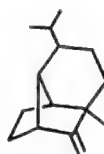
(a) I – A, II – B, III – B, IV – D

(b) I – A, II – A, III – B, IV – D

(c) I – B, II – A, III – B, IV – D

(d) I – B, II – B, III – A, IV – B

67. The structural formula of sativene is shown below. How many stereogenic centers are there in this molecule?



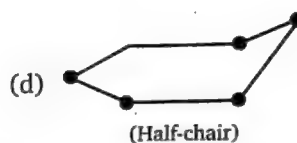
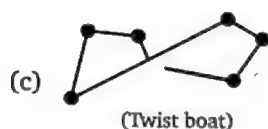
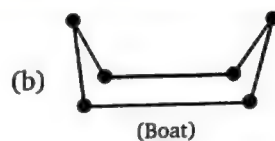
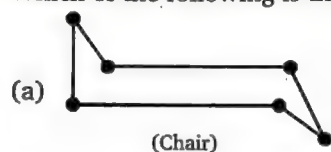
(a) 2

(b) 3

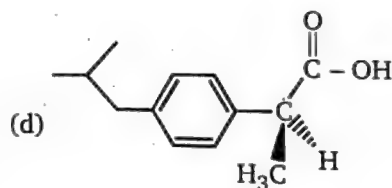
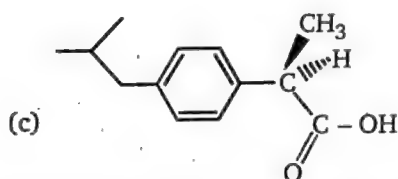
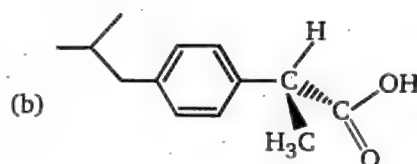
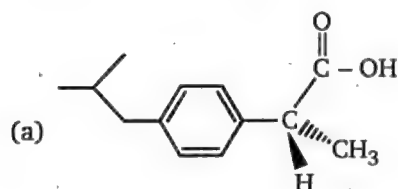
(c) 4

(d) 5

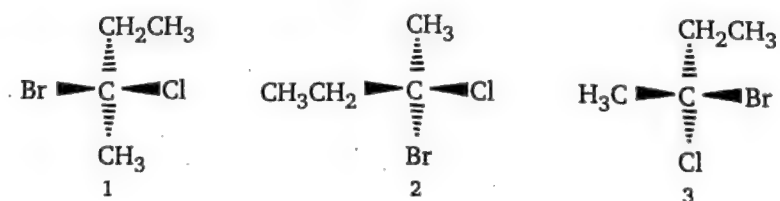
68. Which of the following is the least stable conformer of cyclohexane ?



69. The S- enantiomer of ibuprofen is responsible for its pain-relieving properties. Which one of the following structures shown below is (S)-ibuprofen ?



70. Which of the following depict the same ?



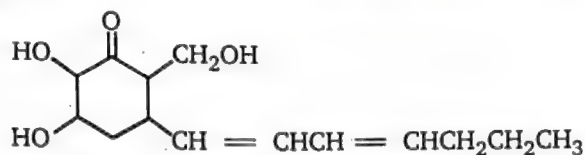
(a) 1 and 2

(b) 1 and 3

(c) 2 and 3

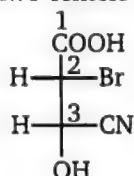
(d) 1, 2, and 3

71. A naturally occurring substance has the constitution shown below. How many may have this constitution ?



- (a) 2 (b) 8 (c) 16 (d) 64

72. The absolute configurations of the two centers in the following molecule are :

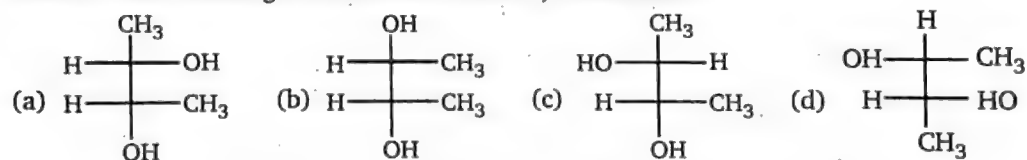


- (a) 2(R), 3(S) (b) 2(R), 3(R) (c) 2(S), 3(S) (d) 2(S), 3(R)

73. The total number of stereoisomer possible for 2, 3-dichloro butane :

- (a) 2 (b) 3  
(c) 4 (d) 5

74. Which of the following structure is not meso-2,3-butanediol ?

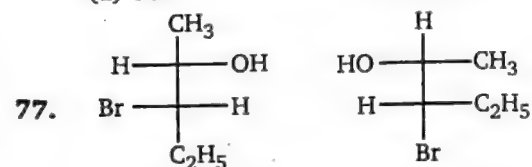


75. A solution of optically active 1-phenylethanol racemizes in acidified aqueous medium. It is due to :

- (a) enolization (b) carbonium ion formation  
(c) carbanion formation (d) reversible oxidation-reduction

76. The most stable conformation of ethylene glycol is :

- (a) Anti (b) Gauche (c) Partially eclipsed (d) Fully eclipsed



77.

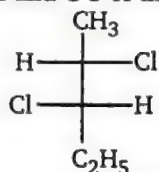
The molecules represented by the above two structures are :

- (a) identical (b) enantiomers  
(c) diastereomers (d) epimers

78. The correct order of priority of groups  $-\text{SCH}_3$  (I),  $-\text{NO}_2$  (II),  $-\text{C}\equiv\text{CH}$  (III) and  $-\text{CH}_2\text{C}_6\text{H}_5$  (IV), on the basis of CIP classification, is (increasing order) :

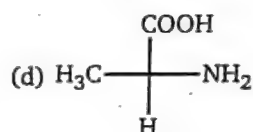
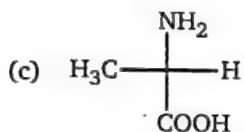
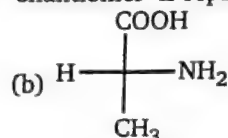
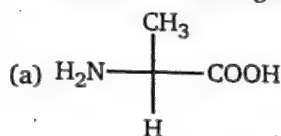
- (a) I, III, II, IV (b) IV, III, II, I  
(c) II, IV, I, III (d) III, IV, II, I

79. The configuration at C-2 and C-3 of the compound given :

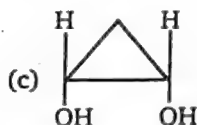
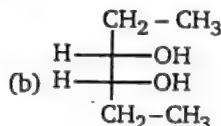
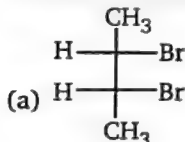


- (a) 2R, 3S                      (b) 2S, 3R                      (c) 2S, 3S                      (d) 2R, 3R

80. Amongst the following amino acids, the (R) - enantiomer is represented by :



81. Which of the following is a meso compound ?

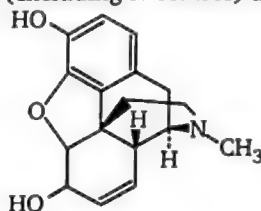


(d) All of these

82. Predict stereochemistry of product when d and l-amine reacts with l-acid:

- (a) Diastereomers                      (b) Meso  
(c) Racemic                              (d) Pure Enantiomer

83. How many chiral center (excluding N centres) are there in morphine?



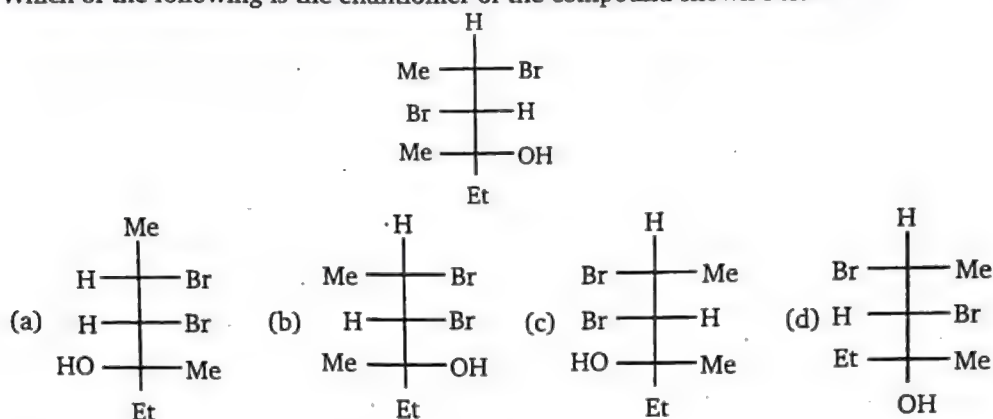
- (a) 4                                      (b) 5  
(c) 6                                      (d) More than 6

84. Which dimethylcyclobutane is optically active ?

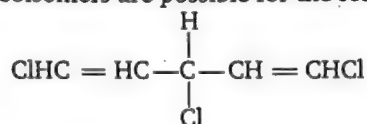
- (a) *trans*-1, 2                              (b) *cis*-1, 2  
(c) *trans*-1, 3                              (d) *cis*-1, 3



85. Which of the following is the enantiomer of the compound shown below ?

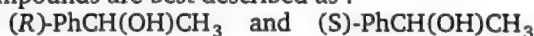


86. How many different stereoisomers are possible for the following compound ?



- (a) 1                      (b) 2                      (c) 3                      (d) 4

87. The following compounds are best described as :



- (a) enantiomers  
 (b) diastereomers  
 (c) not stereoisomers  
 (d) conformational isomers (differing by single bond rotation)
88. Rank the following substituent groups in order of decreasing priority according to the Cahn-Ingold-Prelog system :



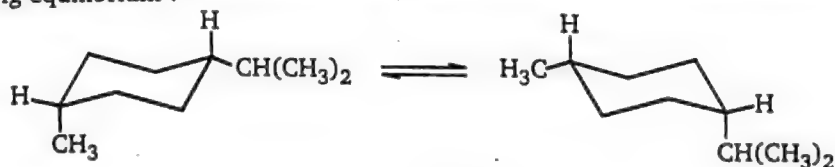
- (a) 2 > 3 > 1              (b) 1 > 3 > 2              (c) 3 > 1 > 2              (d) 2 > 1 > 3

89. Compare the stabilities of the following two compounds :

A : *cis*-1-Ethyl-3-methylcyclohexane

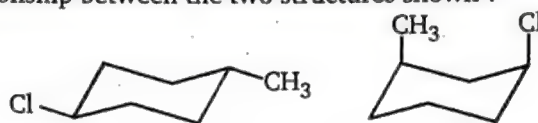
B : *trans*-1-Ethyl-3-methylcyclohexane

- (a) A is more stable                      (b) A and B are of equal stability  
 (c) B is more stable                      (d) No comparison can be made
90. What, if anything, can be said about the magnitude of the equilibrium constant *K* for the following equilibrium ?

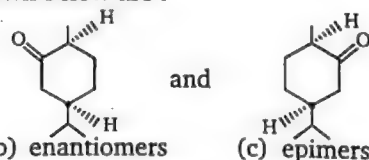


- (a) *K* = 1                      (b) *K* < 1  
 (c) *K* > 1                      (d) No estimate of *K* can be made

91. What is the relationship between the two structures shown ?



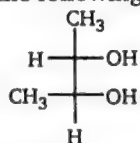
- (a) Constitutional isomers  
 (b) Stereoisomers  
 (c) Different drawing of the same conformation of the same compound  
 (d) Different conformation of the same compound
92. Which of the following statements is true ?  
 (a) van der Waals' strain in *cis*-1, 2-dimethylcyclopropane is the principal reason for its decreased stability relative to the *trans* isomer  
 (b) Cyclohexane gives off more heat per  $\text{CH}_2$  group on being burned in air than any other cycloalkane  
 (c) The principal source of strain in the boat conformation of cyclohexane is angle strain  
 (d) The principal source of strain in the gauche conformation of butane is torsional strain
93.  $\text{Ph}-\text{CH}=\text{NO}_2\text{H} \xrightarrow[3\text{ days}]{\text{isomerises}}$  (x), Isomer (x) is :  
 (a)  $\text{Ph}-\text{NO}-\text{CH}_2\text{OH}$   
 (b)  $\text{Ph}-\text{CH}_2-\text{NO}_2$   
 (c)  $\text{Ph}-\text{NH}-\text{CO}_2\text{H}$   
 (d) None
94. Which of the following will not show geometrical isomerism ?  
 (a)  $\text{CH}_3-\text{C}(\text{CH}_3)=\text{CH}-\text{CH}_2-\text{CH}_3$   
 (b)  $\text{CH}_3-\text{CH}(\text{CH}_3)-\text{CH}=\text{CH}-\text{CH}_2-\text{CH}_3$   
 (c)  $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}_3$   
 (d)  $\text{CH}_3-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-\text{CH}_3$
95. The two compounds shown below are :



- (a) diastereomers (b) enantiomers (c) epimers (d) regiomers
96. The molecular formula of diphenylmethane, is  $\text{C}_{13}\text{H}_{12}$  ;

How many structural isomers are possible when one of the hydrogen is replaced by a chlorine atom ?

- (a) 6 (b) 4 (c) 8 (d) 7
97. Correct configuration of the following molecule is :



- (a) 2S, 3S (b) 2S, 3R (c) 2R, 3S (d) 2R, 3R

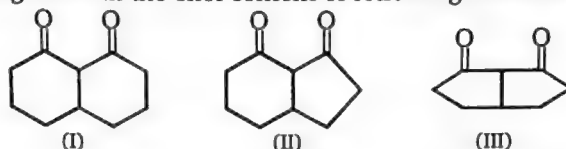
98. Maximum enol content is in :



99. Which of the following will have one of the stereoisomer meso ?

- (a) 2-chlorobutane (b) 2, 3-dichlorobutane  
(c) 2,3-dichloropentane (d) 2-hydroxypropanoic acid

100. The correct decreasing order in the enol content of following molecules is :



- (a) I > II > III (b) II > I > III (c) III > II > I (d) II > III > I

101. Total number of stereoisomers of the compound 1-bromo-3-chlorocyclobutane is:

- (a) 0 (b) 1 (c) 2 (d) 3

102. Total number of stereoisomers of the 1,3-dichlorocyclohexane is:

- (a) 0 (b) 1 (c) 3 (d) 4

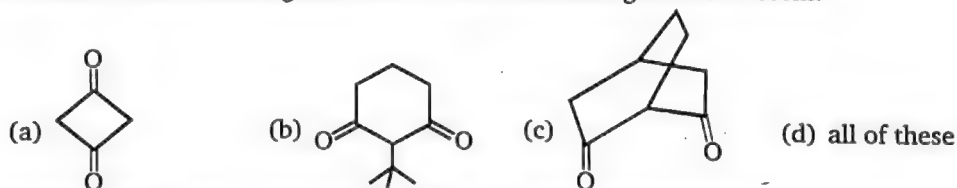
103. Total number of stereoisomers of the compound 1, 4-dichlorocyclohexane is :

- (a) 0 (b) 1 (c) 2 (d) 4

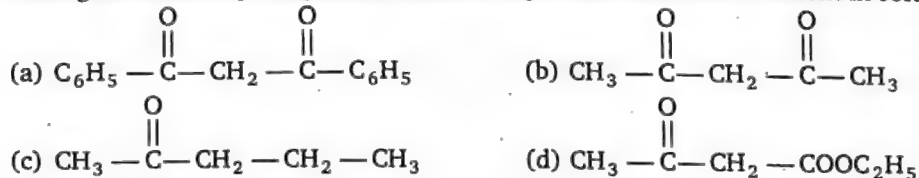
104. Total number of stereoisomers of the compound 2-4-dichloroheptane is:

- (a) 0 (b) 2 (c) 3 (d) 4

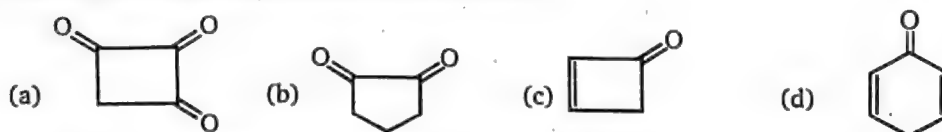
105. In which of the following keto form is more dominating than enol form:



106. Among the following compounds, which will give maximum enol content in solution :



107. Which of the following has unstable enol form ?

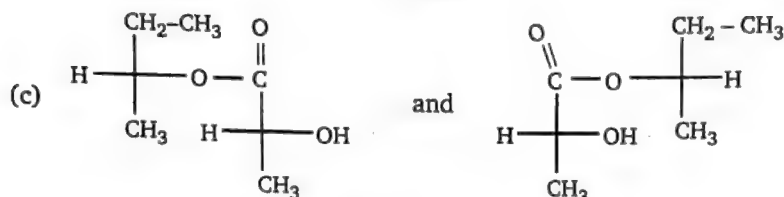
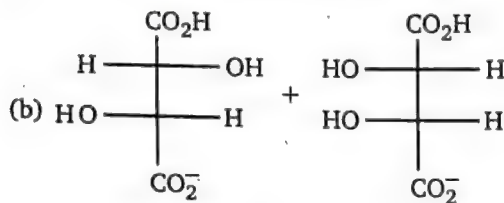


108. Calculate enantiomeric excess of mixture containing 6g of (+) 2-butanol and 4g of (-) 2-butanol.

- (a) 10%                      (b) 20%                      (c) 40%                      (d) 33%

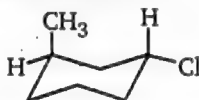
109. Which of the following pair represent pair of diastereomers ?

- (a) Meso tartaric acid and (*D*) tartaric acid



- (d) All of these

110. The stereochemistry of this molecule is :

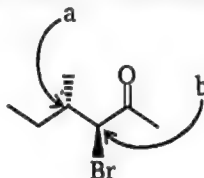


- (a) 1R, 3R                      (b) 1R, 3S                      (c) 1S, 3S                      (d) 1S, 3R

111. Pure (*S*)-2-butanol has a specific rotation of +13.52 degrees. A sample of 2-butanol prepared in the lab and purified by distillation has a calculated specific rotation of +6.76 degrees. What can you conclude about the composition ?

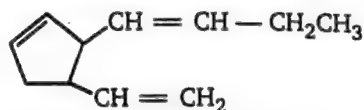
- (a) 50% (*S*), 50% impurity                      (b) 50% (*S*), 50% (*R*)  
(c) 50% (*S*), 50% racemic                      (d) some other mixture

112. Determine the absolute configurations of the chiral centres in the following compound.



- (a) a = R; b = S                      (b) a = R; b = R  
(c) a = S; b = S                      (d) a = S; b = R

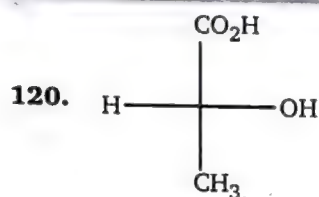
113. Total number of stereoisomers possible for following compound is :



- (a) 8                      (b) 16                      (c) 32                      (d) 64



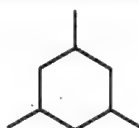




How many representations of lactic acid are possible in Fischer projection (*d* & *l*) ?

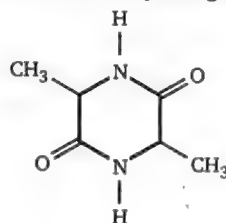
- (a) 8 (b) 12  
(c) 24 (d) 36

121. Total number of stereoisomer formed by the given compound is :



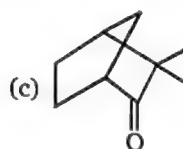
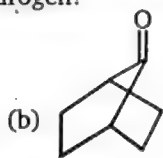
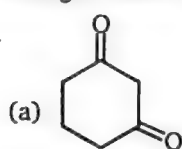
- (a) 2 (b) 3  
(c) 4 (d) 8

122. The number of stereoisomers formed by the given compound is :

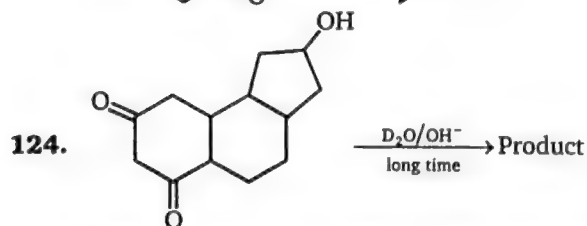


- (a) 2 (b) 3  
(c) 4 (d) 5

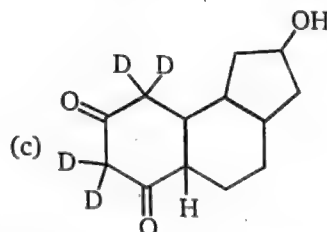
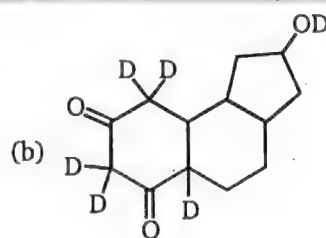
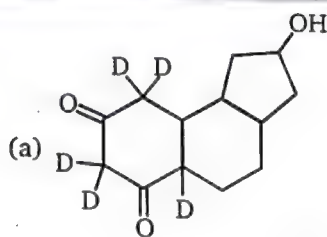
123. Which of the following compound does not undergo base-catalyzed exchange in  $D_2O$  even though it has an  $\alpha$ -hydrogen?



(d) both (b) & (c)

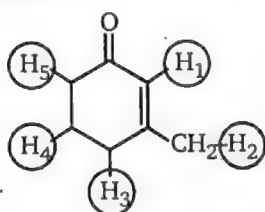


Identify the product formed in the above reaction:



(d) None of these

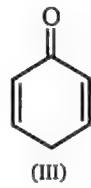
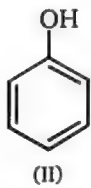
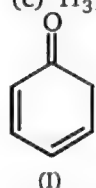
125. In 3-methyl-2-cyclohexenone which hydrogen cannot undergo deuterium exchange when it reacts with  $\text{CH}_3\text{O}^-/\text{CH}_3\text{OD}$ ?



- (a)  $\text{H}_1, \text{H}_4$   
(c)  $\text{H}_3, \text{H}_2$

- (b)  $\text{H}_4$   
(d)  $\text{H}_5, \text{H}_3$

126.

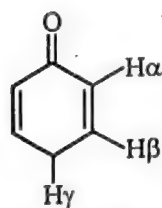


The tautomer of II is :

- (a) I  
(c) both I and III

- (b) III  
(d) none of these

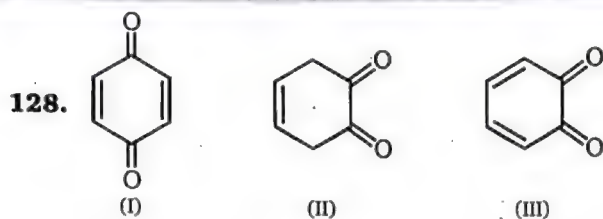
127.



In the enolization of the given molecule, the H-atom involved is :

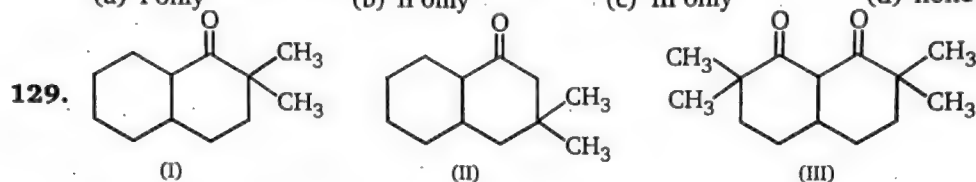
- (a)  $\alpha$ -H  
(c)  $\gamma$ -H

- (b)  $\beta$ -H  
(d) cannot be enolized



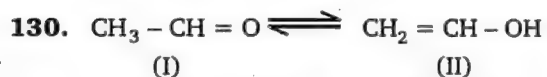
Among the given structure which can exhibit tautomerism ?

- (a) I only (b) II only (c) III only (d) none of these



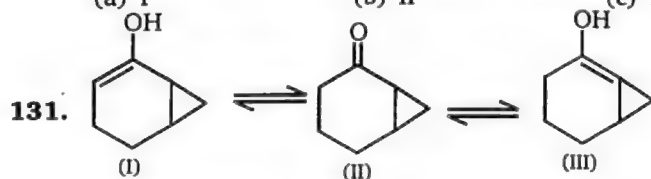
Identify the which can exhibit tautomerism ?

- (a) I only (b) II only (c) III only (d) all of these



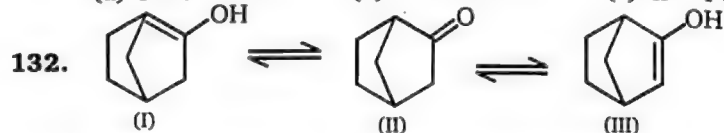
Between the two tautomers which is more stable ?

- (a) I (b) II (c) I = II (d) none of these



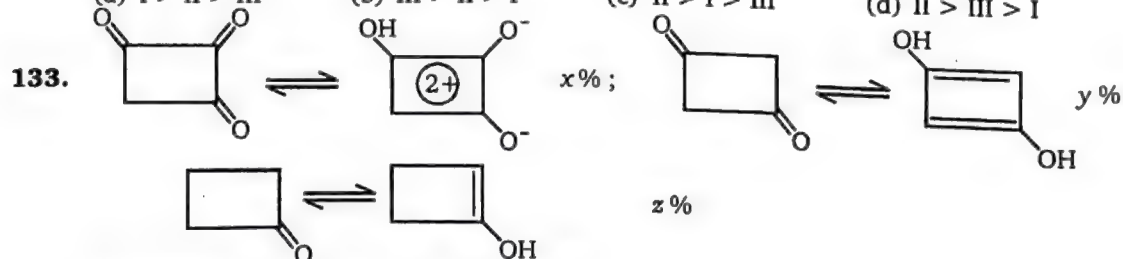
Correct stability order of the given tautomers is :

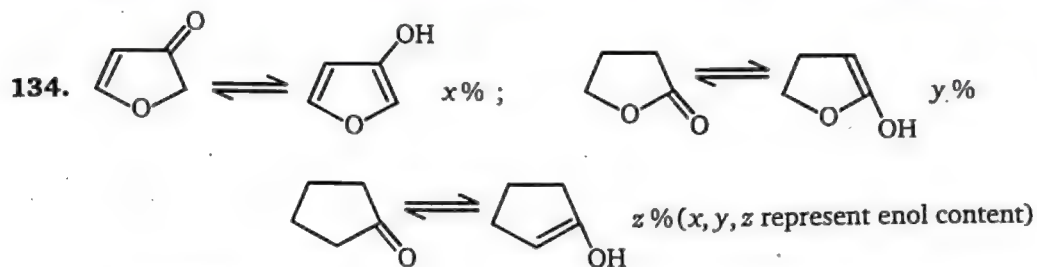
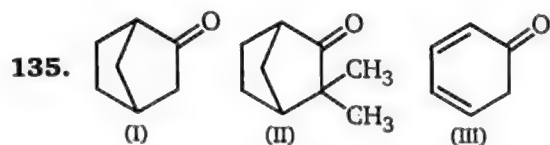
- (a) I > II > III (b) III > II > I (c) II > I > III (d) II > III > I



Correct stability order of the given tautomers is :

- (a) I > II > III (b) III > II > I (c) II > I > III (d) II > III > I



(a)  $x > y > z$ (b)  $z > y > x$ (c)  $y > x > z$ (d)  $x > z > y$ The correct order of  $x, y, z$  is :(a)  $x > y > z$ (b)  $z > y > x$ (c)  $y > x > z$ (d)  $x > z > y$ 

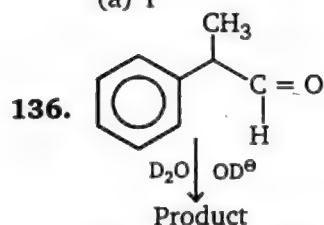
Among the given ketones, the one which does not enolize is :

(a) I

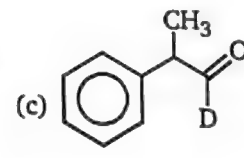
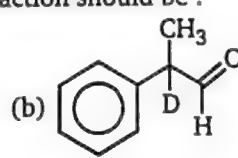
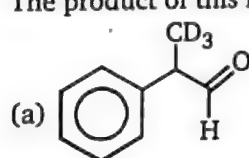
(b) II

(c) III

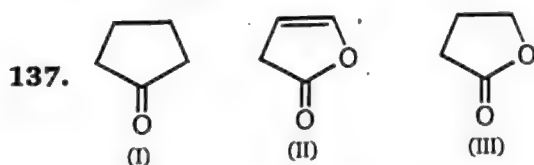
(d) none of these



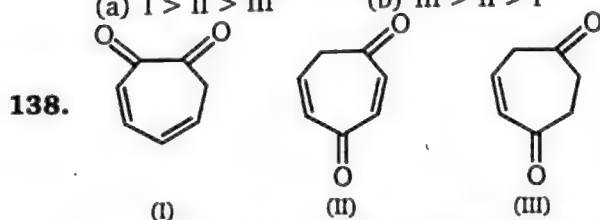
The product of this reaction should be :



(d) All of these

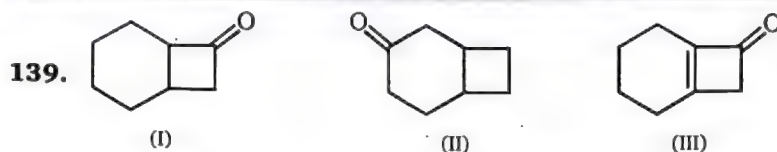


Among the given compounds, the correct order of enol content is :

(a)  $I > II > III$ (b)  $III > II > I$ (c)  $II > I > III$ (d)  $II > III > I$ 

Among the given compounds, the correct order of enol content is :

(a)  $I > II > III$ (b)  $III > II > I$ (c)  $II > I > III$ (d)  $II > III > I$



Among the given compounds, the correct order of enol content is :

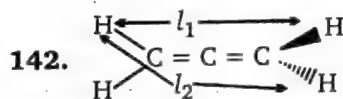
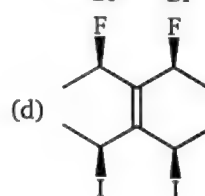
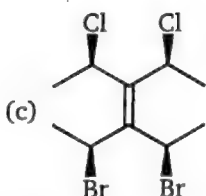
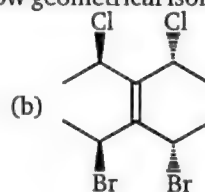
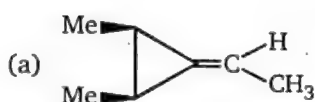
- (a)  $I > II > III$       (b)  $III > II > I$       (c)  $III > I > II$       (d)  $II > I > III$

140. 

How many geometrical isomers are possible for the above compound ?

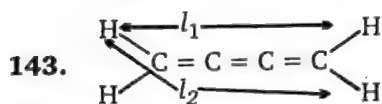
- (a) 3      (b) 4      (c) 6      (d) 8

141. Which of the following compound will not show geometrical isomerism across the  $\pi$ -bond ?



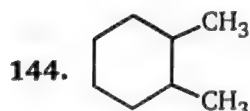
Choose the correct relation between  $l_1$  and  $l_2$  ?

- (a)  $l_1 = l_2$       (b)  $l_1 > l_2$       (c)  $l_1 < l_2$       (d)  $l_2 = 2l_1$



Choose the correct relation between  $l_1$  and  $l_2$  ?

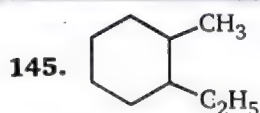
- (a)  $l_1 = l_2$       (b)  $l_1 > l_2$       (c)  $l_1 < l_2$       (d)  $l_2 = 2l_1$



How many geometrical isomers are possible for the above compound ?

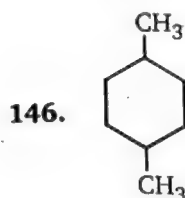
- (a) 0      (b) 2      (c) 3      (d) 4





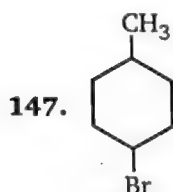
How many geometrical isomers are possible for the above compound ?

- (a) 0 (b) 2 (c) 3 (d) 4



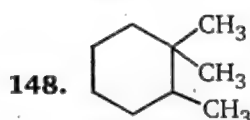
How many geometrical isomers are possible for the above compound ?

- (a) 0 (b) 2 (c) 3 (d) 4



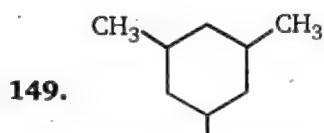
How many geometrical isomers are possible for the above compound ?

- (a) 0 (b) 2 (c) 3 (d) 4



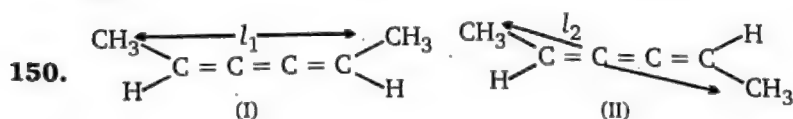
How many geometrical isomers are possible for the above compound ?

- (a) 0 (b) 2 (c) 3 (d) 4



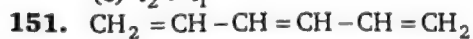
How many geometrical isomers are possible for the above compound ?

- (a) 0 (b) 2 (c) 3 (d) 4



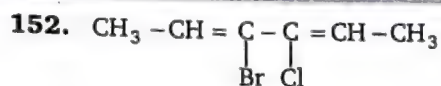
I and II are geometrical isomers of each other because

- (a)  $l_1 = l_2$  (b)  $l_1 > l_2$   
(c)  $l_2 > l_1$  (d)  $l_1$  and  $l_2$  cannot be compared.



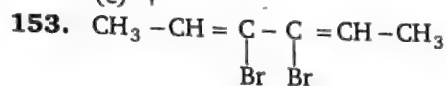
How many geometrical isomers are possible for this compound ?

- (a) 2 (b) 3 (c) 4 (d) 8



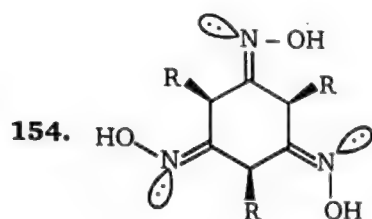
How many geometrical isomers are possible for this compound?

- (a) 2 (b) 3  
(c) 4 (d) 6

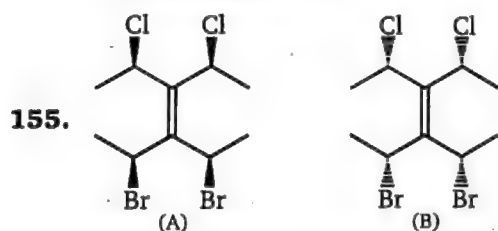


How many geometrical isomers of this compound are possible ?

- (a) 2 (b) 3  
(c) 4 (d) 6

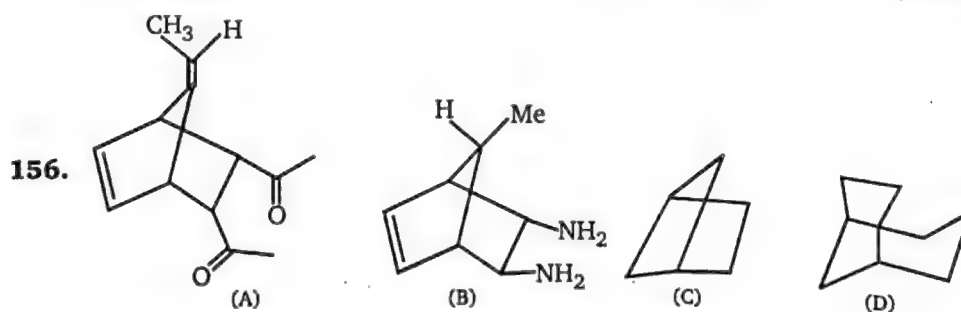


- (a) chiral (b)  $\text{C}_3$  axis of symmetry  
(c) Optically active (d) All of these



Relationship between above pair (A) & (B) is :

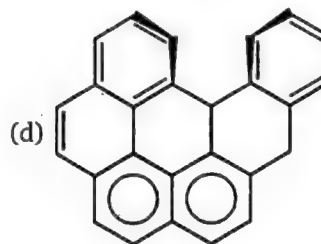
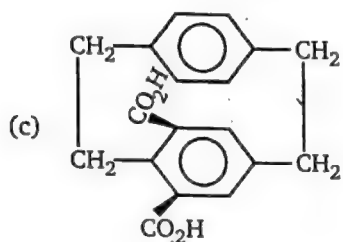
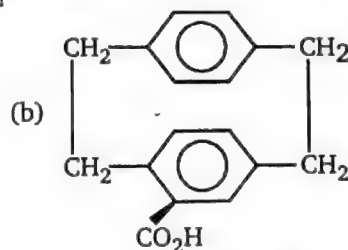
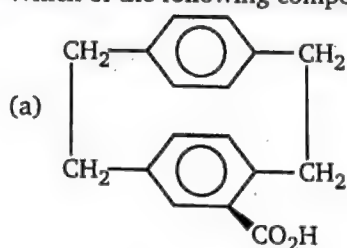
- (a) Enantiomer (b) Diastereomers (c) Identical (d) Structural isomer



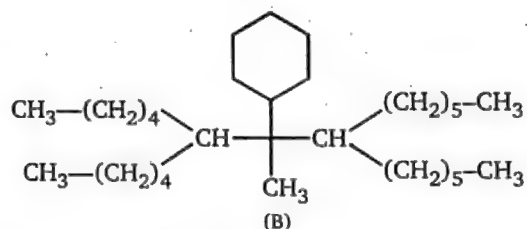
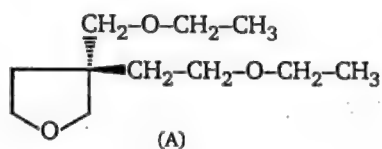
From the above compound (A), (B), (C) & (D) chiral compound is :

- (a) A (b) B (c) C (d) D

157. Which of the following compound is achiral ?



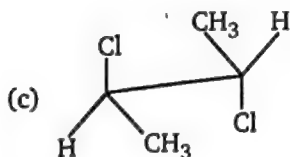
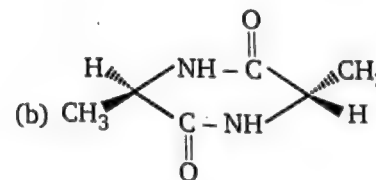
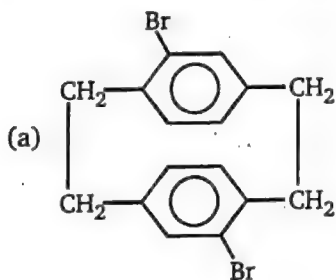
158.



R and S configuration of compound (A) & (B) will be :

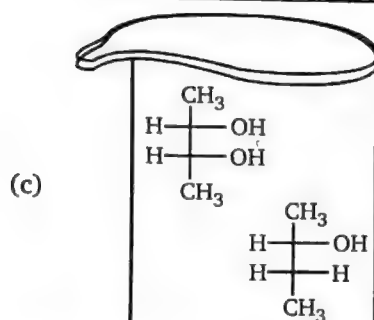
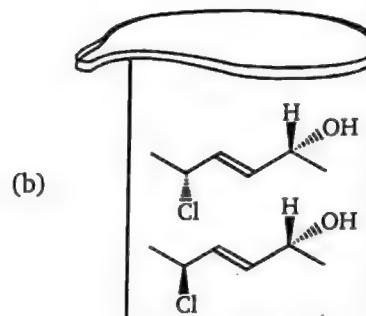
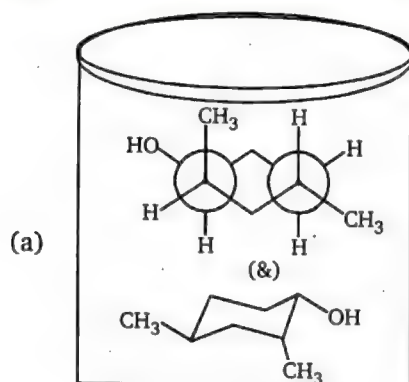
- (a) R, R (b) R, S  
(c) S, R (d) S, S

159. Which of following compound has center of symmetry?



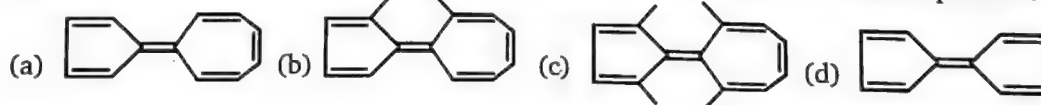
(d) All of these

160. Which mixture of structure in each beaker would rotate plane polarized light ?

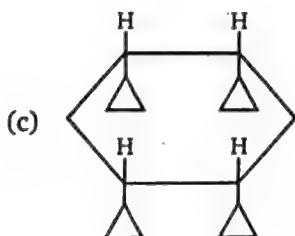
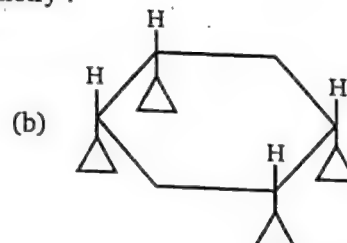
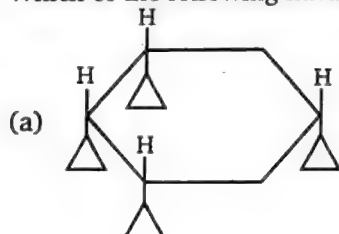


(d) All of these

161. Which of following compound will rotate the plane polarized light at room temperature?

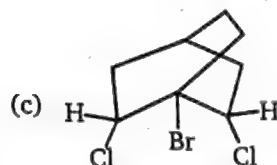
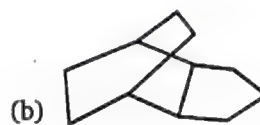
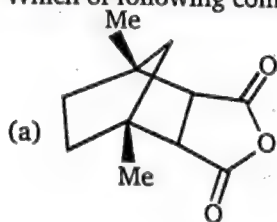


162. Which of the following having plane of symmetry ?



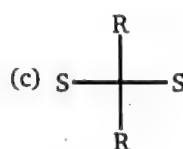
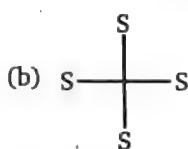
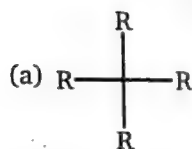
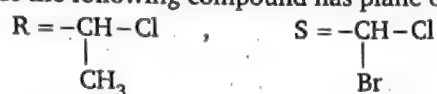
(d) All of these

163. Which of following compound is achiral ?



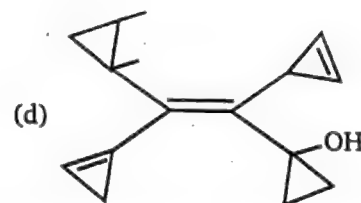
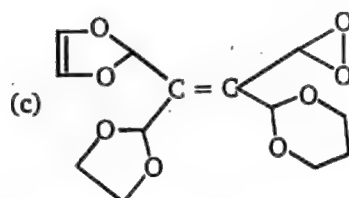
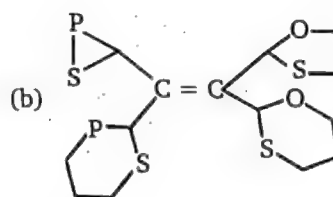
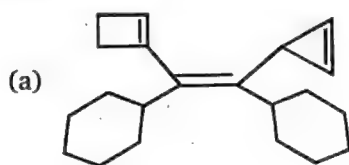
(d) All of these

164. Which of the following compound has plane of symmetry ?

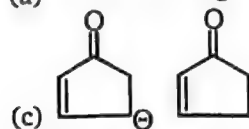
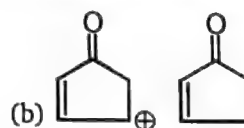
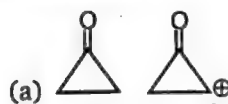


(d) None of these

165. Which of following is E isomer ?



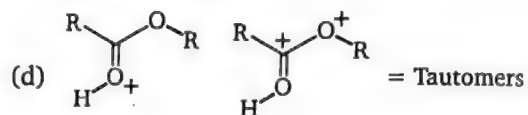
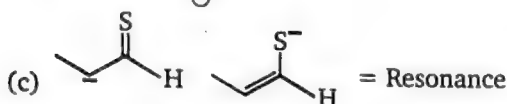
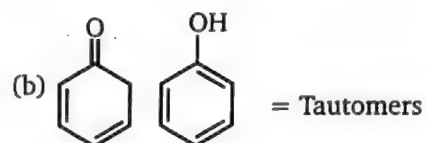
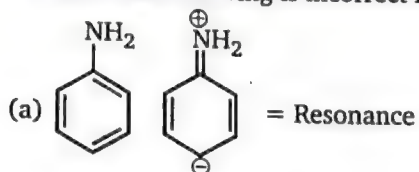
166. Among the given pairs, in which pair second compound has less enol content than first compound?



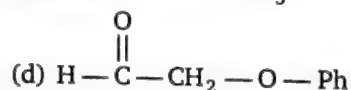
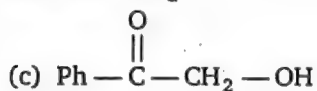
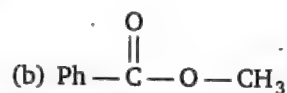
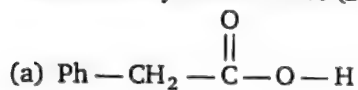
(d) none of these



167. Which of the following is incorrect relation between given pairs ?



168.  $\text{Ph}-\underset{\text{OH}}{\underset{|}{\text{CH}}}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H} \xrightarrow[\text{H}_2\text{O}]{\text{HO}^\ominus} (\text{B})$  ; (A) and (B) are isomer and isomerization effectively carried out by trace of base (B). Identify (B).



169.  $\text{CH}_3-\text{CH}=\text{CH}-\text{CH}=\text{CH}-\text{CH}_3$ ; total number of geometrical isomer is :

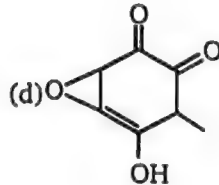
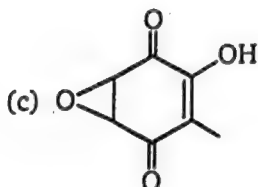
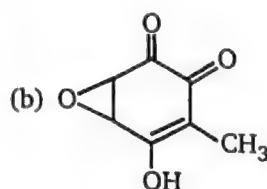
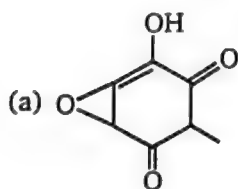
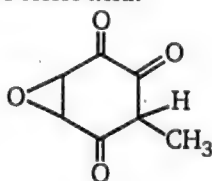
(a) 2

(b) 3

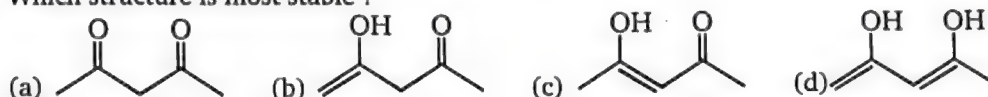
(c) 4

(d) 6

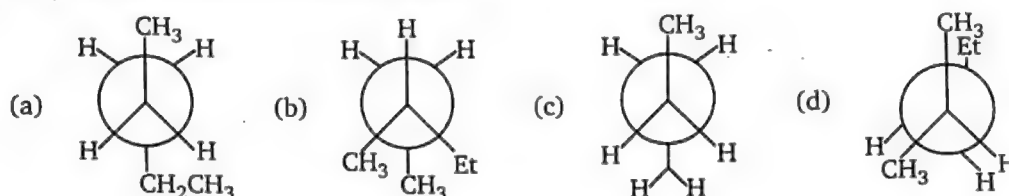
170. Identify most stable enol form of teric acid:



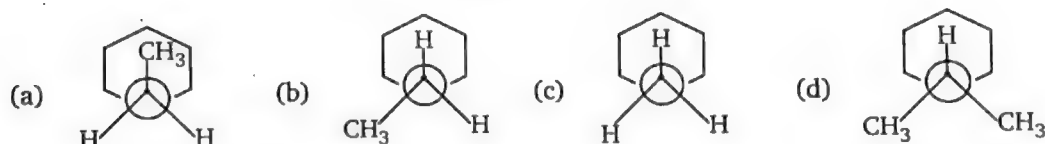
171. Which structure is most stable ?



172. Identify conformer of 2-methyl pentane :



173. The lowest energy conformer of  is:



174.



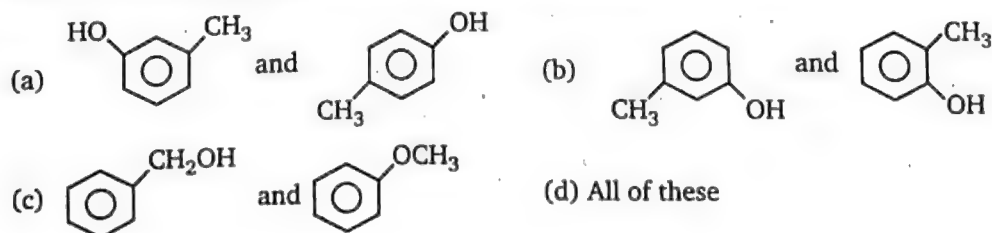
How many atoms will be bisect during plane of symmetry ?

- (a) 2 (b) 4 (c) 6 (d) 8

175. The number of all types of isomers of chlorobutane is :



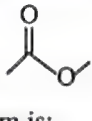

- (a) 2 (b) 4 (c) 6 (d) 5

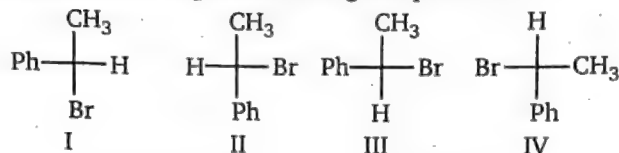
176. Which of the following pairs of compounds are not positional isomers ?



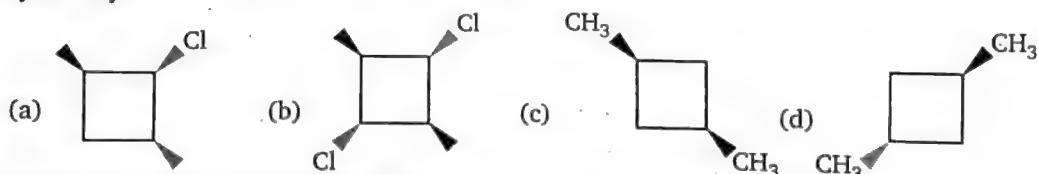
177. Which of the following pairs of compounds are functional isomers ?



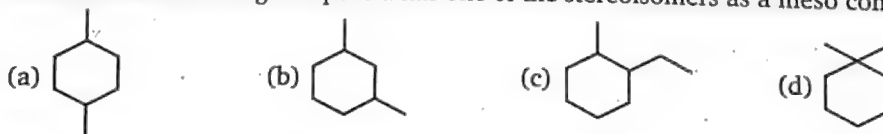
- (c)  and  (d)  and 
178. The isomeric alcohol which has a chiral carbon atom is:  
 (a) *n*-butyl alcohol (b) *iso*-butyl alcohol (c) *sec*-butyl alcohol (d) *tert*-butyl alcohol
179. The pair of enantiomers among the following compound is:



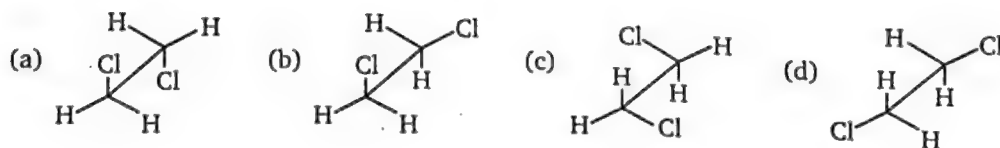
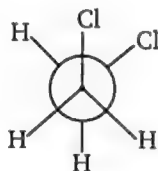
- (a) I and IV (b) II and IV (c) II and III (d) I and II
180. Which of the following is chiral?  
 (a) Cell phone (b) Spiral staircase (c) Scissor (d) All of these
181. In which of the following compound, possess plane of symmetry as well as centre of symmetry?



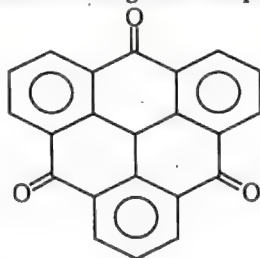
182. Which of the following compound has one of the stereoisomers as a meso compound?



183. For the following Newman projection

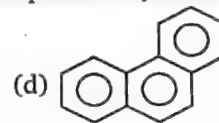
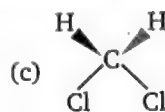
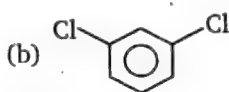
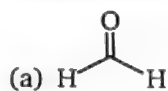


184. Which of the following is correct for the given compound?



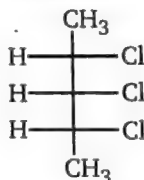
- (a) It possess centre of symmetry  
(b) It possess  $C_4$  axis of symmetry  
(c) It possess plane of symmetry  
(d) Compound is chiral

185. Which of the following molecules has axis of symmetry and a coaxial plane of symmetry?



(e) All of these

186. Number of diastereomer of given compound :



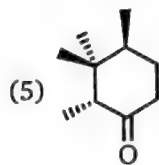
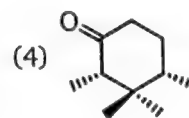
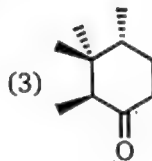
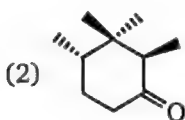
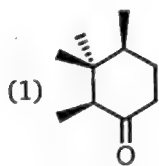
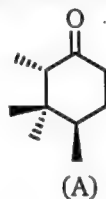
(a) 2

(b) 3

(c) 4

(d) 6

187. Which of the structures is/are diastereomer of A ?



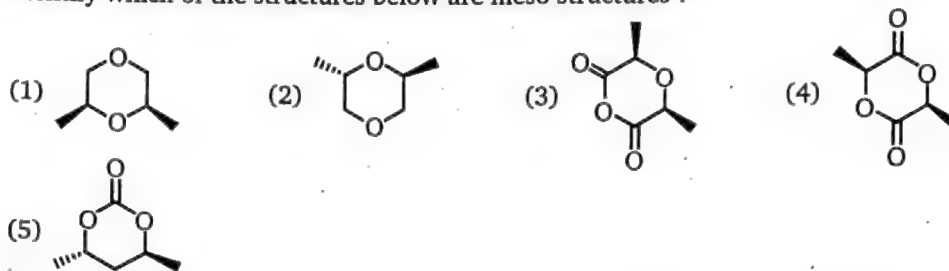
(a) 3

(b) 1 and 4

(c) 2 and 3

(d) 5

188. Identify which of the structures below are meso structures ?

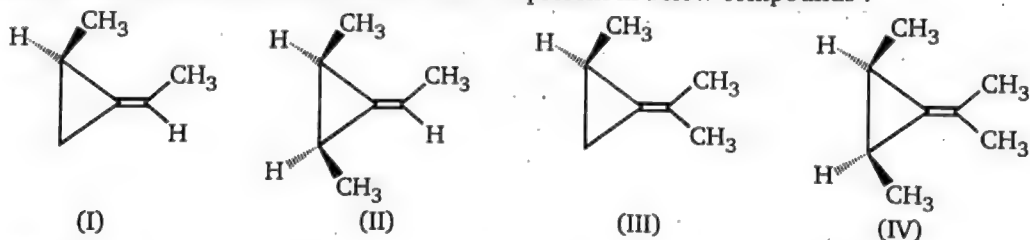


- (a) 1 and 3 (b) 1, 3 and 5 (c) 1, 3 and 4 (d) 2 and 5

189. How many enol form is possible for  $\text{CH}_3 - \text{CH}_2 - \overset{\text{O}}{\parallel} \text{C} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$  (including stereoisomers) will be ?

- (a) 2 (b) 3 (c) 4 (d) 5

190. Find the sum of all the stereocenters that are present in below compounds :



- (a) 8 (b) 9 (c) 10 (d) 11

191. A pair of stereoisomers might be classified in various ways. Which of the following statement are true with respect to pairs of stereoisomers ?

- (a) They might be configurational isomers (b) They might be diastereomers  
(c) They might be constitutional isomers (d) They might be tautomers  
(e) They might be conformational isomers (f) They might be enantiomers  
(g) They might be positional isomers

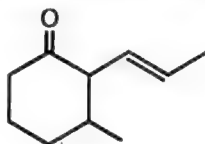
- (a) a, b, c, e (b) b, d, e, f, g (c) a, b, f (d) a, b, c, f

192. Ignoring specific markings, which of the following objects are chiral ?

- (I) a shoe (II) a book (III) a pencil  
(IV) a pair of shoes (consider the pair as one object)  
(V) a pair of scissors

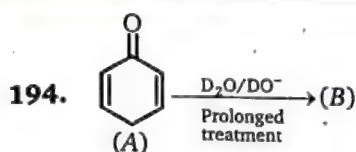
- (a) I only (b) I & V (c) I, IV, V (d) III, IV, V

193. Calculate the total number of stereoisomers when alkene having trans configuration :



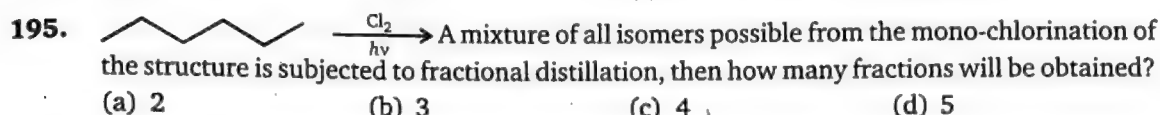
- (a) 2 (b) 3 (c) 4 (d) 8



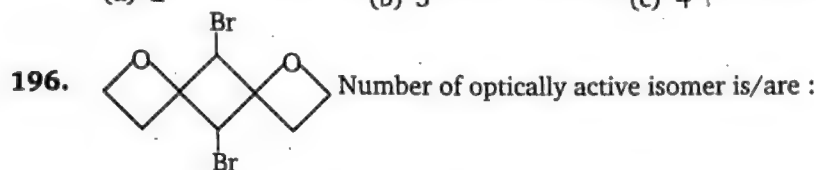


After prolonged treatment of (A) by  $D_2O/DO^-$ , the difference in molecular weights of compounds (A) and (B) is :

- (a) 2 (b) 3 (c) 4 (d) 8

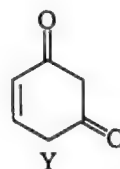
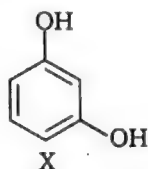


- (a) 2 (b) 3 (c) 4 (d) 5



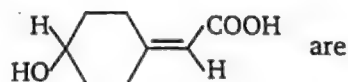
- (a) 0 (b) 1 (c) 2 (d) 3

197. At normal temperature, X and Y



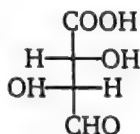
- (a) resonance structures (b) tautomers  
(c) functional isomers (d) positional isomers

198. Two possible stereoisomers for



- (a) enantiomers (b) diastereomers (c) conformers (d) rotamers

199. The configurations of the carbon atoms  $C_2$  and  $C_3$  in the following compound are respectively



- (a) R, R (b) S, S (c) R, S (d) S, R

200. The compound that is chiral is

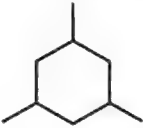
- (a) 3-methyl-3-hexene (b) 4-chloro-1-methylcyclohexane  
(c) 2-phenylpentane (d) 1, 3-disopropylbenzene

ANSWERS - LEVEL 1															
1.	(b)	2.	(c)	3.	(b)	4.	(c)	5.	(a)	6.	(b)	7.	(c)	8.	(d)
9.	(c)	10.	(d)	11.	(b)	12.	(c)	13.	(a)	14.	(b)	15.	(b)	16.	(d)
17.	(c)	18.	(a)	19.	(b)	20.	(b)	21.	(d)	22.	(b)	23.	(c)	24.	(d)
25.	(a)	26.	(b)	27.	(d)	28.	(b)	29.	(a)	30.	(c)	31.	(c)	32.	(a)
33.	(b)	34.	(c)	35.	(c)	36.	(d)	37.	(c)	38.	(d)	39.	(b)	40.	(a)
41.	(a)	42.	(d)	43.	(a)	44.	(d)	45.	(a)	46.	(b)	47.	(c)	48.	(b)
49.	(c)	50.	(c)	51.	(d)	52.	(d)	53.	(e)	54.	(a)	55.	(d)	56.	(c)
57.	(d)	58.	(b)	59.	(a)	60.	(a)	61.	(c)	62.	(d)	63.	(e)	64.	(d)
65.	(b)	66.	(b)	67.	(d)	68.	(d)	69.	(d)	70.	(d)	71.	(d)	72.	(a)
73.	(b)	74.	(a)	75.	(b)	76.	(b)	77.	(a)	78.	(b)	79.	(c)	80.	(b)
81.	(d)	82.	(a)	83.	(b)	84.	(a)	85.	(a)	86.	(d)	87.	(a)	88.	(d)
89.	(a)	90.	(b)	91.	(a)	92.	(a)	93.	(b)	94.	(a)	95.	(b)	96.	(b)
97.	(a)	98.	(d)	99.	(b)	100.	(a)	101.	(c)	102.	(c)	103.	(c)	104.	(d)
105.	(d)	106.	(a)	107.	(c)	108.	(b)	109.	(d)	110.	(a)	111.	(c)	112.	(c)
113.	(a)	114.	(d)	115.	(b)	116.	(b)	117.	(c)	118.	(d)	119.	(b)	120.	(c)
121.	(a)	122.	(b)	123.	(d)	124.	(b)	125.	(b)	126.	(c)	127.	(c)	128.	(b)
129.	(d)	130.	(a)	131.	(c)	132.	(d)	133.	(d)	134.	(d)	135.	(b)	136.	(b)
137.	(c)	138.	(a)	139.	(d)	140.	(b)	141.	(b)	142.	(a)	143.	(c)	144.	(b)
145.	(b)	146.	(b)	147.	(b)	148.	(a)	149.	(b)	150.	(c)	151.	(a)	152.	(c)
153.	(b)	154.	(d)	155.	(c)	156.	(a)	157.	(c)	158.	(d)	159.	(d)	160.	(d)
161.	(b)	162.	(d)	163.	(d)	164.	(d)	165.	(d)	166.	(c)	167.	(d)	168.	(c)
169.	(b)	170.	(c)	171.	(c)	172.	(d)	173.	(b)	174.	(c)	175.	(d)	176.	(c)
177.	(b)	178.	(c)	179.	(c)	180.	(d)	181.	(d)	182.	(b)	183.	(b)	184.	(c)
185.	(e)	186.	(b)	187.	(b)	188.	(a)	189.	(c)	190.	(c)	191.	(c)	192.	(b)
193.	(c)	194.	(c)	195.	(b)	196.	(a)	197.	(b)	198.	(a)	199.	(a)	200.	(c)

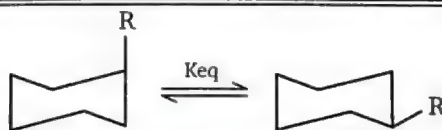


# LEVEL-2

## 1. Match the Column (I) and (II).

Column (I)		Column (II)	
Reaction		Stereoisomers	
(a)	$\text{CH}_3 - \text{CH} = \text{CH} - \text{CH} = \text{N} - \text{OH}$	(p)	2
(b)		(q)	4
(c)	$\text{CH}_3 - \text{CH} = \text{CH} - \text{CH} = \text{CH} - \text{CH} = \text{CH} - \text{CH}_3$	(r)	6
(d)	$\text{CH}_3 - \text{CH} = \text{CH} - \text{CH} = \text{CH} - \text{CH} = \text{CH} - \text{Ph}$	(s)	8

## 2. Match the Column (I) and (II).



Column (I)		Column (II)	
Group		Equilibrium Constant	
(a)	$\text{R} = -\text{H}$	(p)	38
(b)	$\text{R} = -\text{CH}_3$	(q)	23
(c)	$\text{R} = -\text{Et}$	(r)	18
(d)	$\text{R} = -\text{CH}(\text{CH}_3)_2$	(s)	1

## 3. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
Molecule		Nature	
(a)		(p)	Chiral
(b)		(q)	Achiral
(c)		(r)	Meso
(d)		(s)	Compound containing even number of chiral centers

## 4. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
Compound		Isomerism	
(a)		(p)	Geometrical isomerism
(b)		(q)	Optical isomerism
(c)		(r)	Compound containing plane of symmetry
(d)		(s)	Compound containing center of symmetry



## 5. Match the Column (I) and (II).

Column (I)		Column (II)	
Molecules		Relationship	
(a)		(p)	Identical
(b)		(q)	Enantiomer
(c)		(r)	Diastereomer
(d)		(s)	Structural Isomerism

## 6. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
Compound		Nature	
(a)		(p)	cis-compound
(b)		(q)	trans-compound
(c)		(r)	Optically active
(d)		(s)	Optically inactive



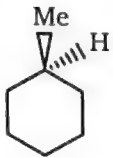
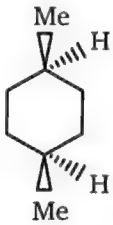
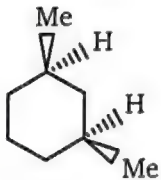
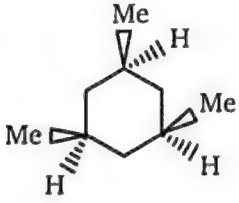
## 7. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
Molecule		Property	
(a)		(p)	Chiral centers containing compound
(b)		(q)	Presence of stereocenter
(c)		(r)	Optically active compound
(d)		(s)	Compound containing plane of symmetry

## 8. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
Molecule		Property	
(a)		(p)	Polar molecule
(b)		(q)	Optically active
(c)		(r)	Optically inactive
(d)		(s)	Plane of symmetry

## 9. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
Molecule		Property	
(a)		(p)	Meso compound
(b)		(q)	Achiral
(c)		(r)	Chiral compound
(d)		(s)	Compound will show geometrical isomerism


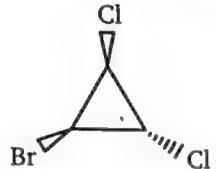
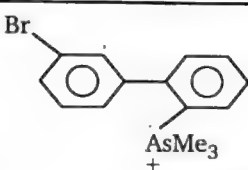
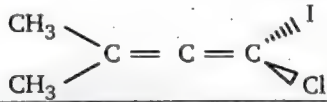
## 10. Match the Column (I) and (II).

Column (I)		Column (II)	
Modified Newmann Projection		Conformers	
(a)		(p)	Fully eclipsed
(b)		(q)	Partially eclipsed
(c)		(r)	Gauche
(d)		(s)	Staggered

## 11. Match the Column (I) and (II).

Column (I)		Column (II)	
Newmann Projection		Name of the Compound	
(a)		(p)	3-methyl pentane
(b)		(q)	n-butane
(c)		(r)	Methyl-cyclopentane
(d)		(s)	1,2,4-trimethyl cyclohexane

## 12. Match the Column (I) and (II). (Matrix)

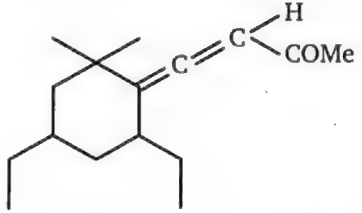
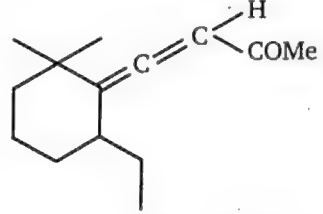
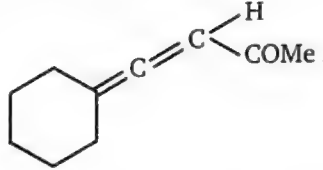
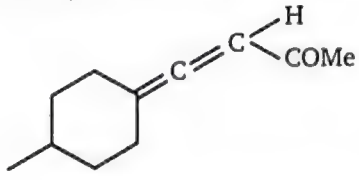
Column (I)		Column (II)	
Molecule		Property	
(a)		(p)	Rotates plane polarized light
(b)		(q)	Cannot rotate plane polarized light
(c)		(r)	Plane of symmetry
(d)		(s)	Centre of symmetry

## 13. Match the Column (I) and (II).

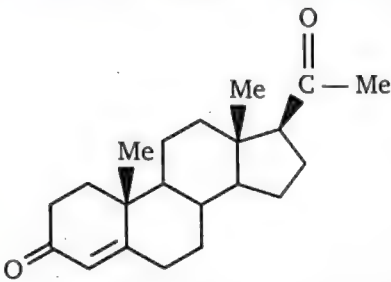
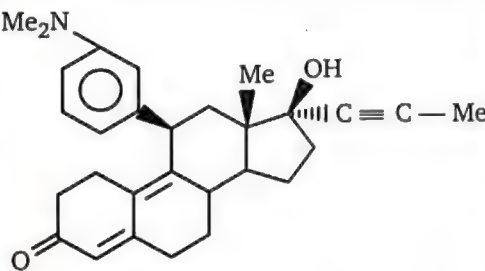
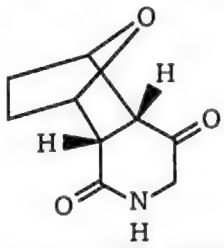
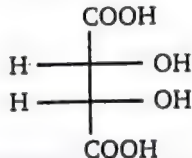
Column (I)		Column (II)	
Molecule		Stereocenters	
(a)	$\text{CH}_3 - \text{CH} = \text{CH} - \underset{\text{Br}}{\text{CH}} - \text{CH}_3$	(p)	1
(b)	$\text{H} - \text{C} \equiv \text{C} - \text{CH} = \text{CH} - \underset{\text{Br}}{\text{CH}} - \underset{\text{Br}}{\text{CH}} - \text{CH}_3$	(q)	2
(c)	$\text{Ph} - \overset{\text{O}}{\parallel}{\text{S}} - \text{CH} = \text{CH} - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_3$	(r)	3
(d)	$\text{Ph} - \underset{\text{Cl}}{\text{CH}} - \text{Et}$	(s)	4



14. Match the Column (I) and (II).

Column (I)		Column (II)	
	Molecule		Stereoisomers
(a)		(p)	2
(b)		(q)	0
(c)		(r)	4
(d)		(s)	8

## 15. Match the Column (I) and (II). (Matrix)

Column (I)		Column (II)	
Molecule		Property	
(a)		(p)	Meso Compound
(b)		(q)	Compound having even no. of chiral centres
(c)		(r)	Optically active compound
(d)		(s)	Compound having odd no. of chiral centres.

## 16. Match the Column (I), (II) and (III). (Matrix)

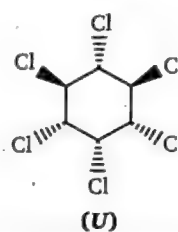
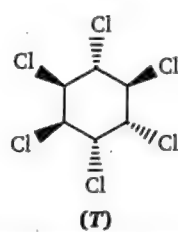
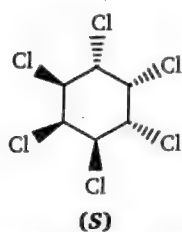
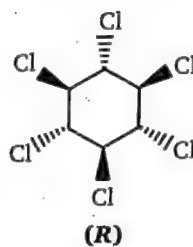
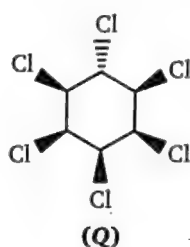
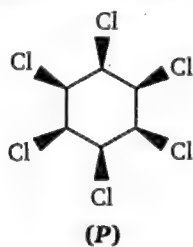
Column (I)		Column (II)		Column (III)	
Property		Molecule		No. of Chiral Center	
(a)		(p)	Optically active	(w)	0
(b)		(q)	Optically inactive	(x)	1
(c)		(r)	Plane of symmetry	(y)	2
(d)		(s)	Centre of symmetry	(z)	3

## 17.

(a)		(b)		(c)	
(d)		(e)		(f)	
(g)		(h)			

From the above compounds select :

(A)	two of which are chiral and contain chiral centre :	
(B)	two of which are achiral and contains chiral centre :	
(C)	two of which are chiral and does not contain chiral centre :	
(D)	two of which are achiral and does not contain chiral centre :	

**18. Comprehension**

Consider the given structures and answer A, B & C.

A. Which of the compound is optically active ?

- (a) P (b) R (c) S (d) T

B. Which of the isomer is most stable ?

- (a) R (b) S (c) T (d) U

19. Identify relationship between following pairs :

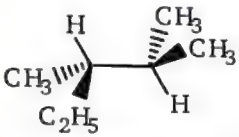
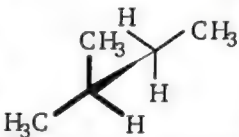
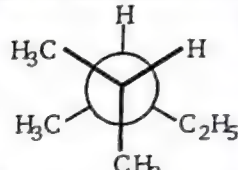
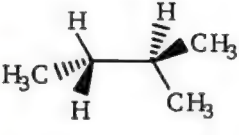
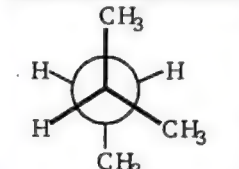
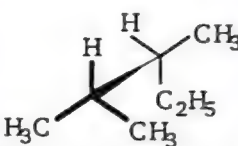
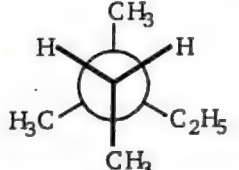
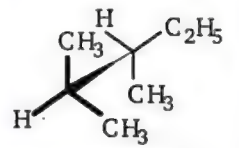
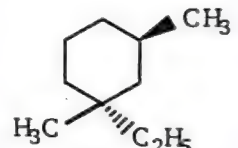
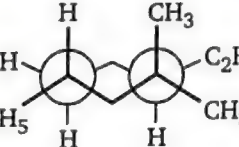
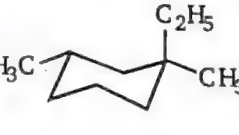
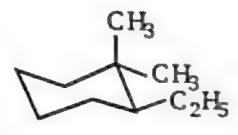
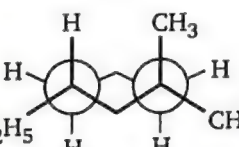
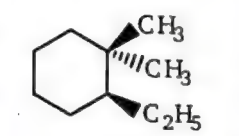
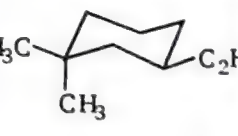
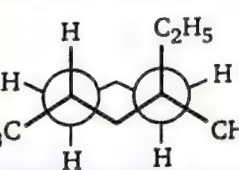
(a)	(b)
(c)	(d)

If they are enantiomer answer will be 1, if they are diastereomers answer will be 2, if they are constitutional isomers answer will be 3 and if they are identical present 4 as the answer. Sum of answer of each part  $a + b + c + d$  is : .....

20. In each of the following three questions a hydrocarbon is named. For each select from among the sixteen conformational structures (a through p) all structures that represent possible conformers of that compound. Write letters (a through p), corresponding to your selections, in each answer box.

<b>A.</b>	2-methylbutane	
<b>B.</b>	2,3-dimethylpentane	
<b>C.</b>	1-ethyl-1, 3-dimethyl cyclohexane	

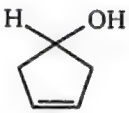

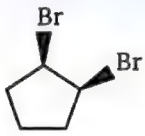

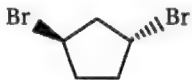
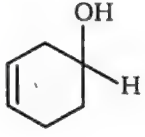
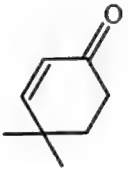
<b>(a)</b>		<b>(b)</b>		<b>(c)</b>	
<b>(d)</b>		<b>(e)</b>		<b>(f)</b>	
<b>(g)</b>		<b>(h)</b>		<b>(i)</b>	
<b>(j)</b>		<b>(k)</b>		<b>(l)</b>	
<b>(m)</b>		<b>(n)</b>		<b>(o)</b>	
<b>(p)</b>					



21. Examine structures a through j, shown below, with respect to their symmetry or lack of it. Assume that the five-membered rings and the ring in compound g are planar. The wedge-hatched bonds in b, c, d & e designate specific configurations. Also, for the acyclic compounds assume stable anti conformations. Answer each of the following questions by writing letters (a through j), corresponding to your selections, in each answer box. If there is no structure that fits the description enter an x in the answer box.

A.	Which structures are chiral ?	
B.	Which structures have a plane of symmetry ?	
C.	Which structures have a center of symmetry ?	

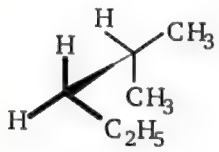
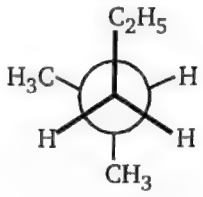
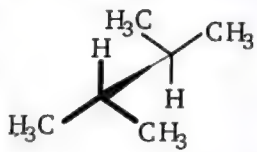
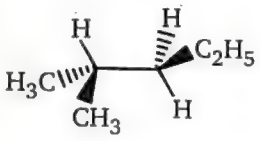
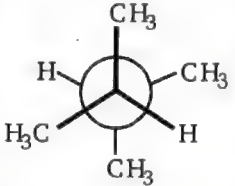
  

(a)		(b)		(c)	
(d)		(e)		(f)	
(g)		(h)	$C_2H_5CHCl_2$	(i)	$C_2H_5CHClC_2H_5$
(j)	$C_2H_5CHClCH_3$				

22. (i) 1,2-dichlorocyclopropane = w  
 (ii) 1,3-dimethyl-cyclobutane = x  
 (iii) 2-bromo-3-chlorobutane = y  
 (iv) 1,3-dimethyl cyclohexane = z  
 Calculate total number of stereoisomer of the above compounds.  
 Sum of  $w + x + y + z = \dots\dots$

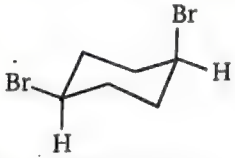
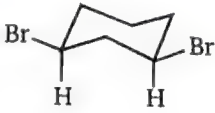
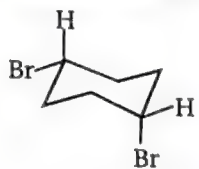
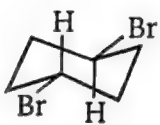
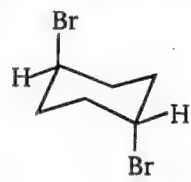
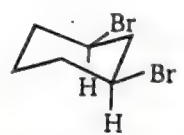


23. Examine the following formulas and select those pairs that satisfy the following conditions :  
Be sure to write two letters (and only two) in each answer box, unless you select f. In the second and third parts more than one answer is possible.

(a)		(b)		(c)	
(d)		(e)		(f)	No formulas meet the designated condition

A.	Which are identical in all respects?	
B.	Which are conformational isomers?	
C.	Which are constitutional isomers?	

24. Examine the following formulas and select those pairs that satisfy the following conditions :  
Be sure to write two letters (and only two) in each answer box. In the second and fourth parts more than one answer is possible.

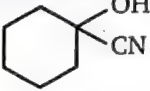
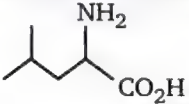
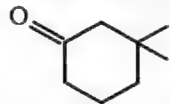
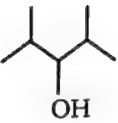
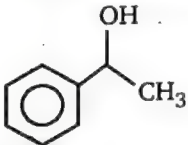
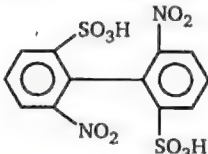
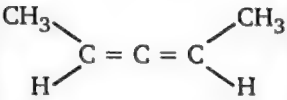
(a)		(b)		(c)	
(d)		(e)		(f)	

A.	Which are identical in all respects?	
B.	Which are configuration isomers?	
C.	Which are conformational isomers?	

25. Consider the following statements regarding the given projection (True or False).

(W)	$  \begin{array}{c}  \text{CH}_2\text{Cl} \\    \\  \text{H} - \text{C} - \text{Br} \\    \\  \text{Cl} - \text{C} - \text{H} \\    \\  \text{CH}_3  \end{array}  $	(X)	$  \begin{array}{c}  \text{CH}_2\text{Cl} \\    \\  \text{Cl} - \text{C} - \text{H} \\    \\  \text{H} - \text{C} - \text{Cl} \\    \\  \text{CH}_3  \end{array}  $
(Y)	$  \begin{array}{c}  \text{CH}_3 \quad \text{H} \\    \quad   \\  \text{Cl} - \text{C} - \text{C} - \text{Br} \\    \quad   \\  \text{H} \quad \text{CH}_2\text{Cl}  \end{array}  $	(Z)	$  \begin{array}{c}  \text{CH}_2\text{Cl} \\    \\  \text{H} \quad \text{Cl} \\  \diagup \quad \diagdown \\  \text{C} \\  \diagdown \quad \diagup \\  \text{H} \quad \text{Cl} \\    \\  \text{CH}_3  \end{array}  $
(a)	W and Y are diastereomers		
(b)	Z is the projection of X		
(c)	W, X, Y and Z are optically active		
(d)	Y and Z are isomer		

26. Examine the following structural formulas and select those that are chiral.

(a)		(b)		(c)	
(d)		(e)	$  \begin{array}{c}  \text{CO}_2\text{H} \\    \\  \text{H} - \text{C} - \text{OH} \\    \\  \text{H} - \text{C} - \text{OH} \\    \\  \text{CH}_2 - \text{CO}_2\text{H}  \end{array}  $	(f)	$  \begin{array}{c}  \text{CN} \\    \\  \text{H} - \text{C} - \text{OH} \\    \\  \text{HO} - \text{C} - \text{CH}_3 \\    \\  \text{CH}_2 - \text{CO}_2\text{H}  \end{array}  $
(g)		(h)		(i)	
(j)	$  \begin{array}{c}  \text{CH}_3 \\    \\  \text{H} - \text{C} - \text{Cl} \\    \\  \text{H} - \text{C} - \text{Cl} \\    \\  \text{CH}_3  \end{array}  $				
Write your choice here					

27. The configuration of eight compounds, a through h are shown below, using various kind of stereo representations. To answer the question given below, write (a through h) indicating your choice.

(a)		(b)		(c)	
(d)		(e)		(f)	
(g)		(h)			

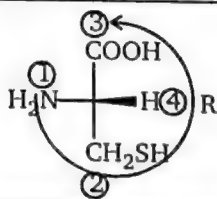
A.	Which of these configuration are achiral?	
B.	Which configuration has no stereogenic center?	
C.	Which configuration has more than one stereogenic center?	
D.	Which of these configuration are meso compound?	

28. The structural formula of ten compounds, (I) through (X) are drawn below, you may select any one of these structure.

Answer the following question about that compound.

I		II		III	
IV		V		VI	
VII		VIII		IX	
X					

- A. How many chiral centre are present in this compound ?  
 (a) 0 (b) 1 (c) 2 (d) 3  
 (e) 4 (f) 5
- B. Is this compound chiral or achiral ?  
 (a) Chiral (b) Achiral
- C. What symmetry element are present in this compound ?  
 (a) None (b) Plane of symmetry (c) Center of symmetry
29. The structure of one of the enantiomers of the amino acid cysteine is shown below.



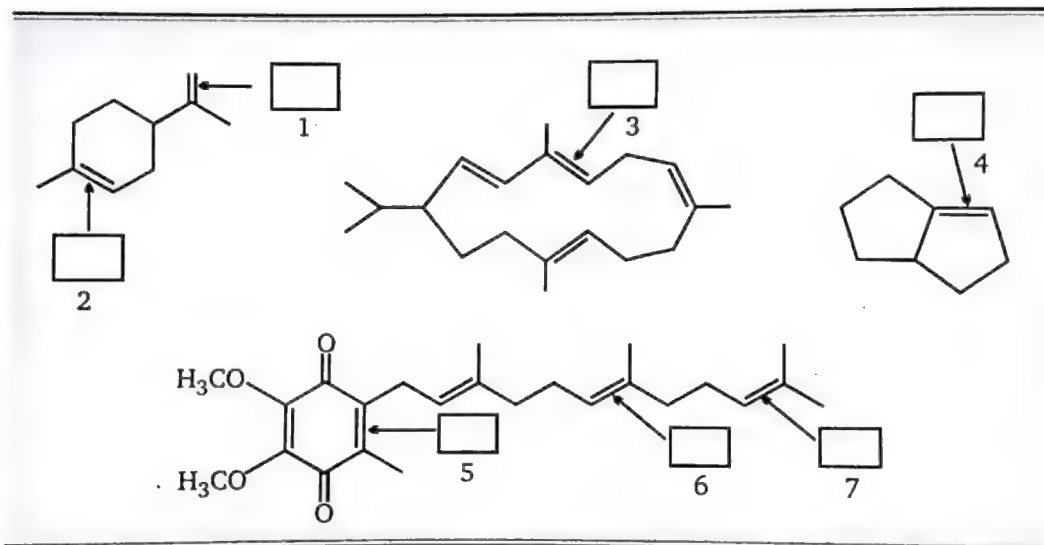
Classify this structure as :

(a) R or S

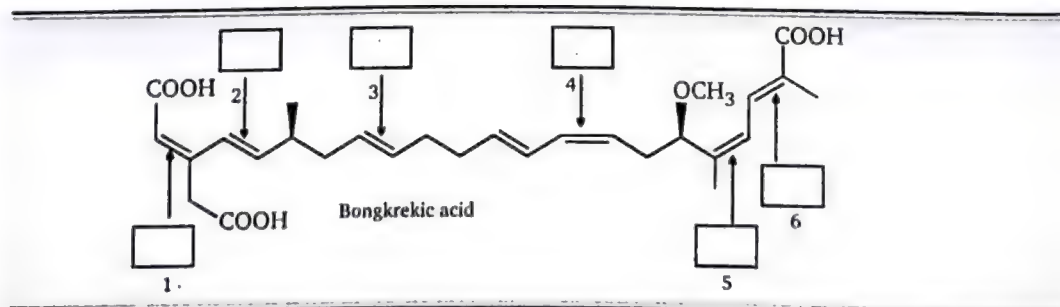
(b) D or L

30. Identify the following double bonds either E, Z or None (N) in the compounds given below either.

A.



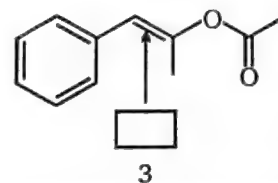
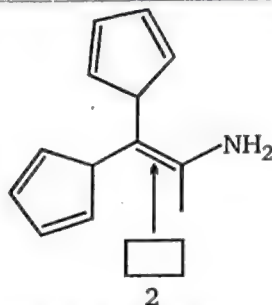
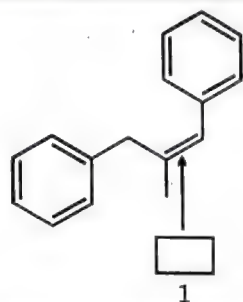
- B. (a) Bongkreic acid is a toxic compound produced by *Pseudomonas cocovenenans*, and isolated from a mold that grows on bongkre, a fermented Indonesian coconut dish. (a) Label each double bond as E, Z or neither (N).



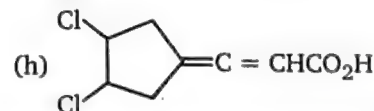
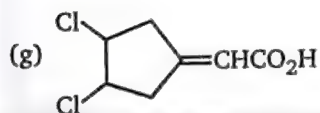
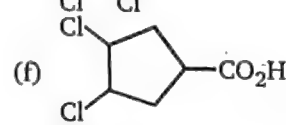
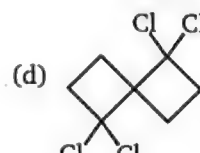
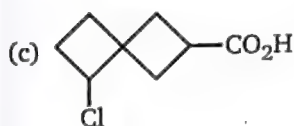
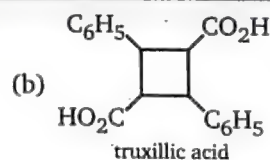
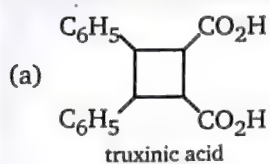
- (b) How many total stereoisomers (including all types) are possible for bongkreic acid ?  
 .....  
 (c) How many sites of unsaturation are present in bongkreic acid ? .....



31. Designate the following double bonds as E, Z or none (N) configuration in the boxes provided below.



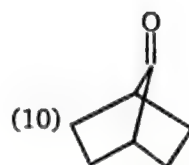
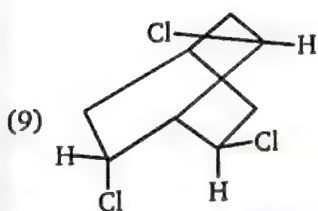
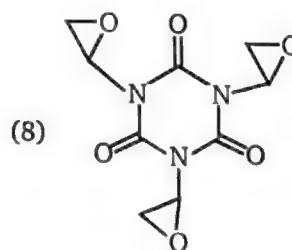
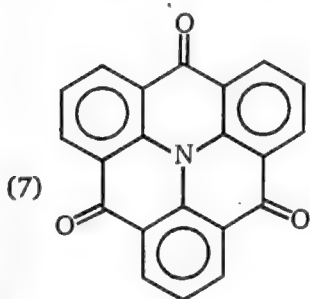
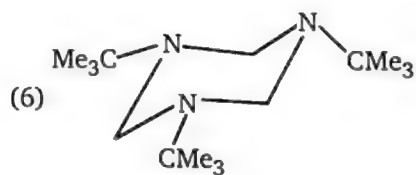
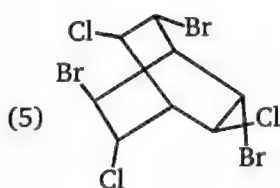
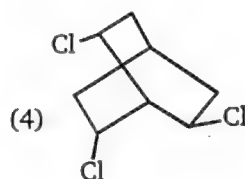
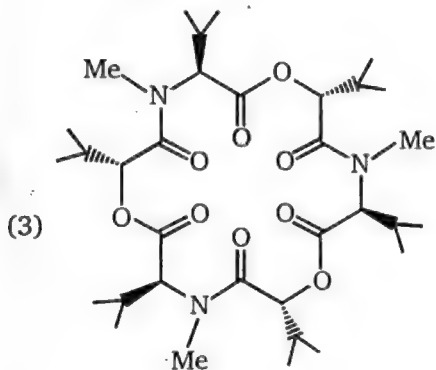
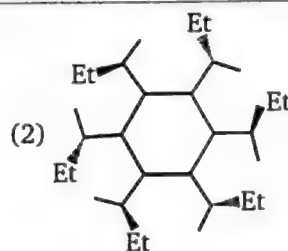
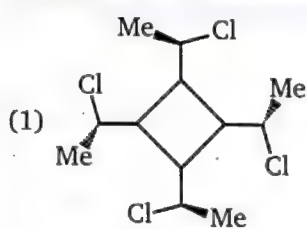
32. The following compounds may exist as two or more stereoisomers. These may be classified as enantiomer pairs or meso compounds.

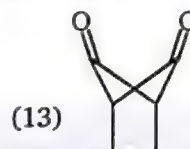
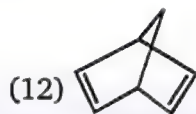
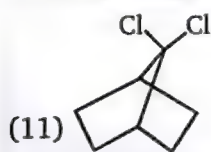


Answer the following question about the above structure.

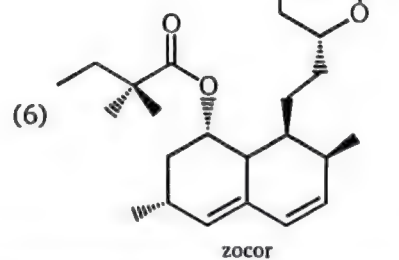
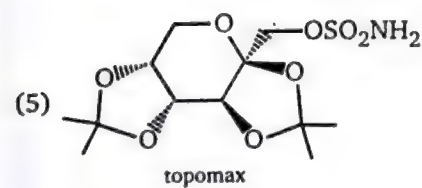
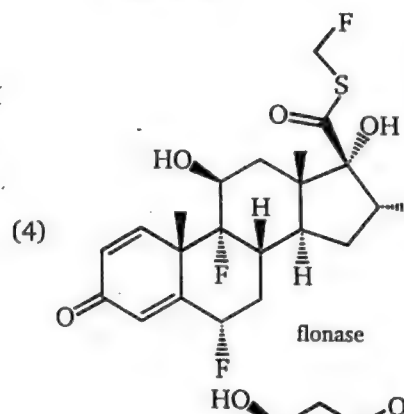
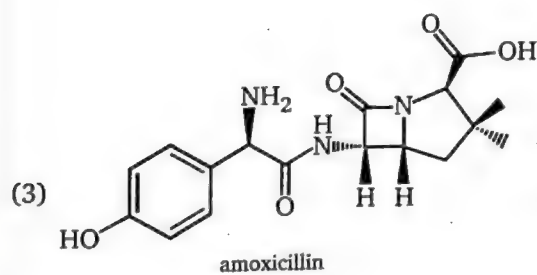
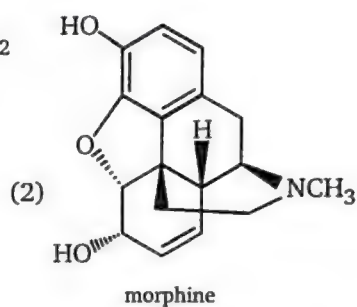
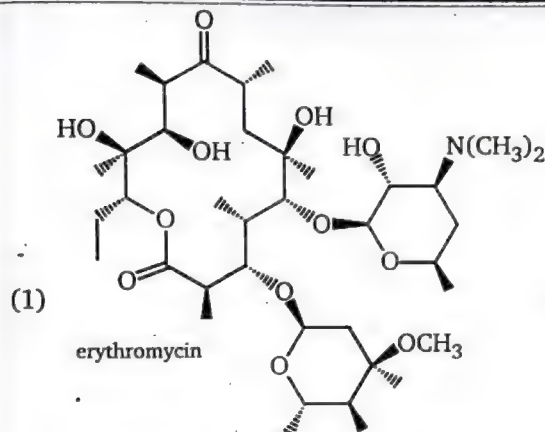
- (A) Total number of stereoisomers :  
 (B) Number of enantiomeric pairs :  
 (C) Number of meso compounds :

33. Identify axis of symmetry in the given compound.





34. For each of the following pharmaceutical compounds, identify all stereogenic (i.e., all asymmetric carbon atoms) and label the configuration of each as being either (R) or (S).



35. Find relationship between given pair :

		Identical	Enantiomer	Diastereomer	Constitutional Isomer
1.					
2.					
3.					
4.					
5.					
6.					
7.					

8.					
9.					
10.					

**36. Comprehension**

Structural formula of compound (A) is following:



- A. The correct statement(s) about the compound (A) is/are:  
 (a) The total number of stereoisomers possible for (A) is 3  
 (b) The total number of mesoisomer possible for (A) is 1  
 (c) The total number of pair of enantiomer possible for (A) is 1  
 (d) All of these
- B. Number of plane of symmetry in *cis*-form of compound (A) is:  
 (a) 0 (b) 1 (c) 2 (d) 3
37. Match the column. (Matrix)

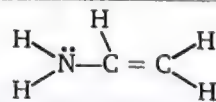
Column (I)		Column (II)	
No. of Carbon		No. of structural isomer	
(a)	$C_4H_{10}$	(p)	2
(b)	$C_5H_{12}$	(q)	3
(c)	$C_6H_{14}$	(r)	5
(d)	$C_7H_{16}$	(s)	9



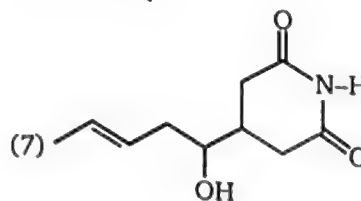
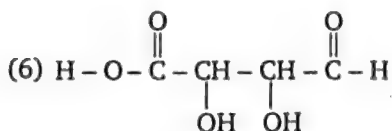
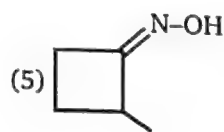
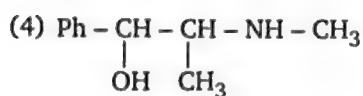
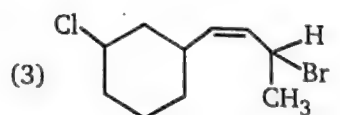
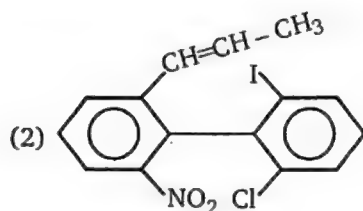
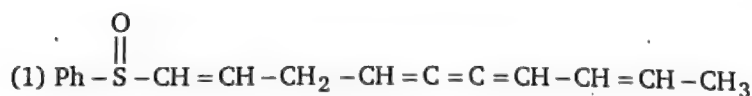
38. Match the column. (Matrix)

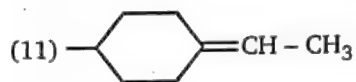
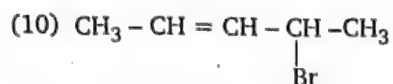
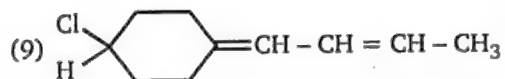
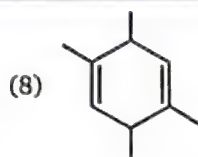
Column (I)		Column (II)	
Compound		% of enol content	
(a)		(p)	100 %
(b)		(q)	76 %
(c)	$\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{CH}_2 - \overset{\text{O}}{\parallel}{\text{C}} - \text{CH}_3$	(r)	8%
(d)	$\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{CH}_2 - \overset{\text{O}}{\parallel}{\text{C}} - \text{O} - \text{Et}$	(s)	Keto-Enol is not possible

39. Draw a most stable conformation (N - C) bond in the following compound.

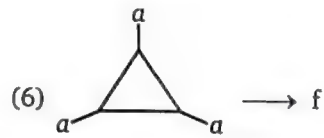
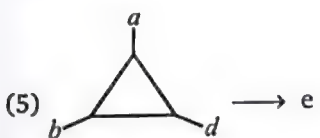
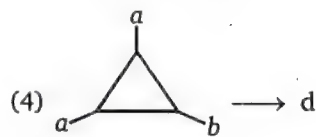
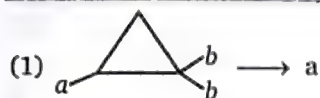


40. Find total number of stereoisomers for each compound given below :




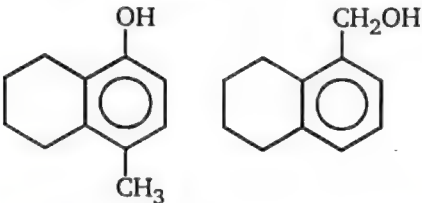


41. Find the total number of stereoisomer for each compound :

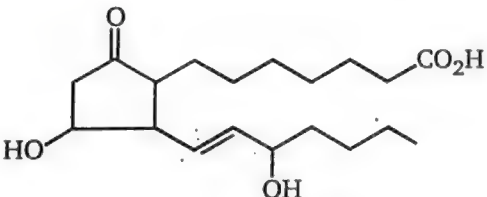
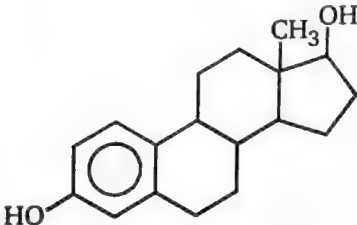
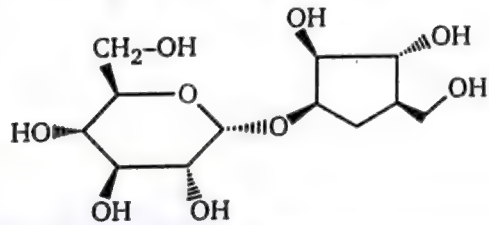


42. Match the column :

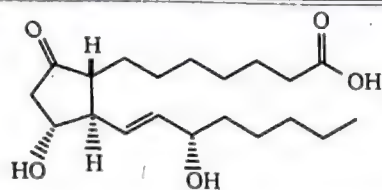
Column (I)		Column (II)	
Pair		Isomeric Relationship	
(a)		(p)	Chain
(b)	$\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \overset{\text{O}}{\parallel} \text{C} - \text{OH}, \text{CH}_3 - \underset{\text{CO}_2\text{H}}{\text{CH}} - \text{CH}_3$	(q)	Positional

(c)		(r)	Functional
(d)		(s)	Metamers

43. Find sum of stereoisomer of following compound.

	Number of stereoisomers
(a) 	(a)
(b) 	(b)
(c) $\text{HOCH}_2\text{-CH-CH-CH-CH-CH}_2\text{-CH-CH-CH-CH-CH}_2\text{-OH}$ with stereochemical wedges and dashes on the chiral centers.	(c)
(d) 	(d)

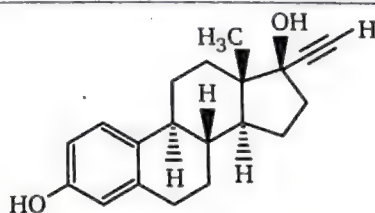
44.

1 Prostaglandin E<sub>1</sub>

Prostaglandin E<sub>1</sub> 1 is a compound produced by the body to regulate a variety of processes including blood clotting, fever, pain and inflammation.

- A. Which of the following functional groups is not contained in 1 ?  
 (a) A ketone (b) An alcohol (c) A carboxylic acid (d) An alkene  
 (e) A nitrile
- B. How many asymmetric (stereogenic) centres are present in compound 1 ?  
 (a) 3 (b) 4 (c) 5 (d) 6
- C. How many  $sp^2$  hybridised carbon atoms are present in compound 1 ?  
 (a) 1 (b) 2 (c) 3 (d) 4
- D. What is the geometric configuration about the double bond in compound 1 ?  
 (a) E (b) Z

45.

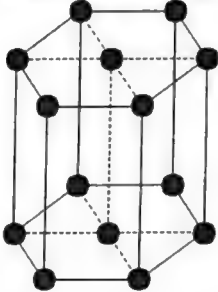
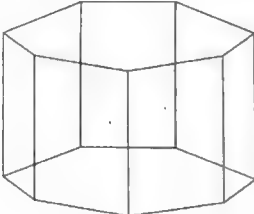
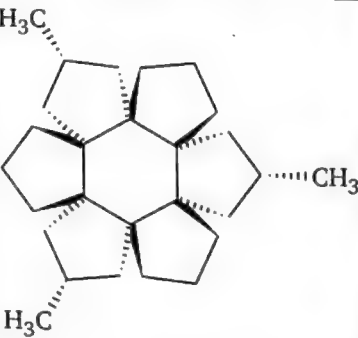
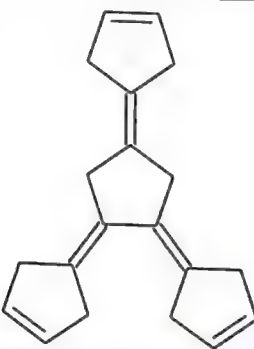


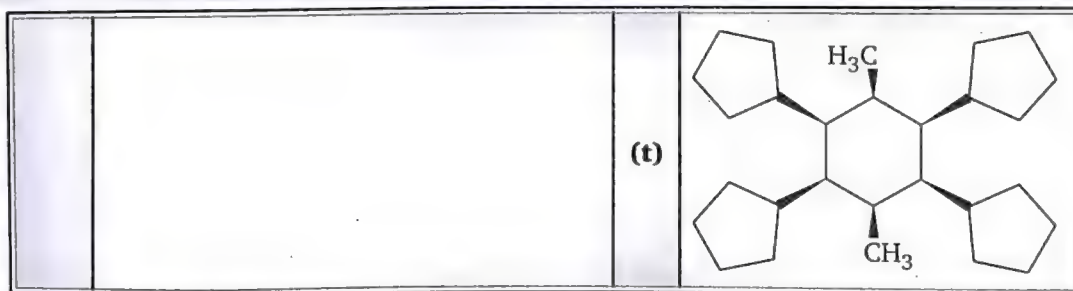
Ethynylestradiol (1)

The synthetic steroid ethynylestradiol (1) is a compound used in the birth control pill.

- A. How many  $sp^3$  hybridised carbon atoms are present in compound (1) ?  
 (a) 8 (b) 9 (c) 10 (d) 11 (e) 12
- B. How many  $sp^2$  hybridised carbon atoms are present in compound (1) ?  
 (a) 4 (b) 5 (c) 6 (d) 7 (e) 8
- C. How many  $sp$  hybridised carbon atoms are present in compound (1) ?  
 (a) 2 (b) 4 (c) 6 (d) 8 (e) 10
- D. Which of the following functional group is contained in compound (1) ?  
 (a) A ketone (b) An alcohol (c) A carboxylic acid (d) An ester
- E. How many asymmetric (stereogenic) centres are present in compound (1) ?  
 (a) 2 (b) 3 (c) 4 (d) 5

46. Match the column.

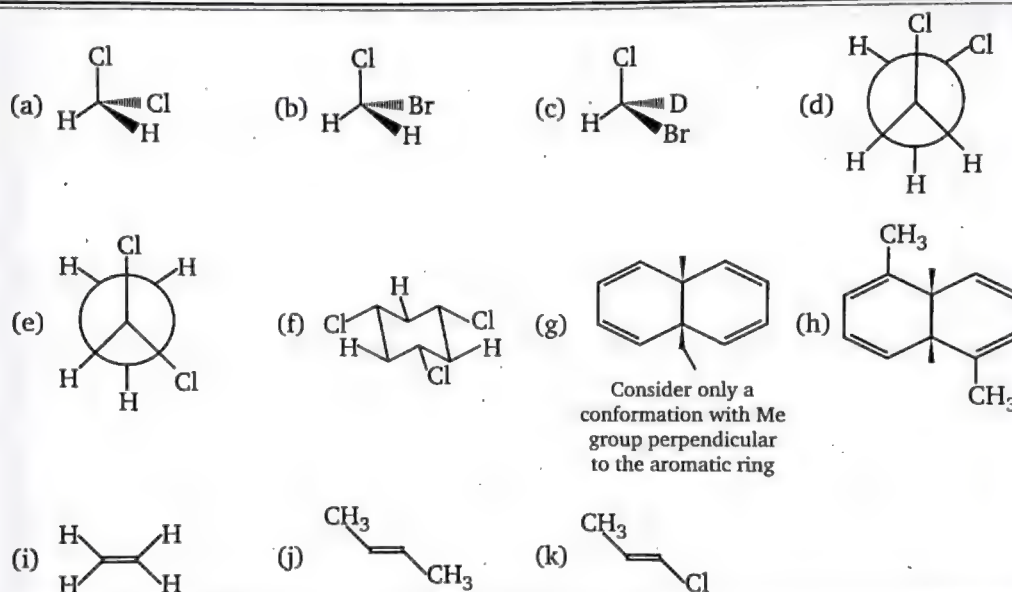
Column (I)		Column (II)	
(a)	$C_2$ -axis of symmetry	(p)	
(b)	$C_3$ -axis of symmetry	(q)	
(c)	Plane of symmetry	(r)	
(d)	Centre of symmetry	(s)	



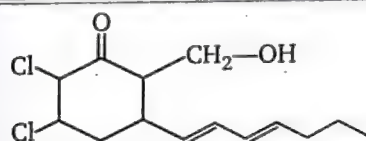


## SUBJECTIVE PROBLEMS

1. Number of chiral isomers are:

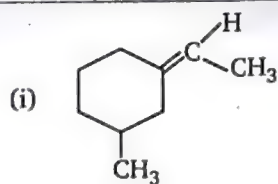


2.

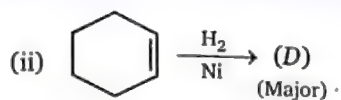


Number of stereoisomer are

3.



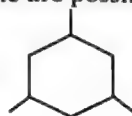
(C)



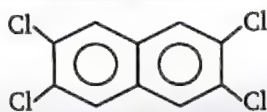
Sum of number of stereoisomer (C) Degree of unsaturations in (D).

4. How many 5 membered parent chain alkane are possible for  $\text{C}_7\text{H}_{16}$ ?

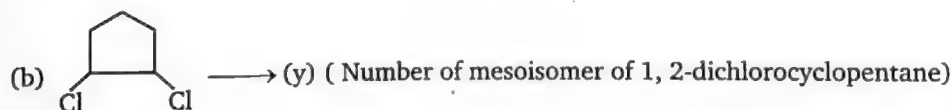
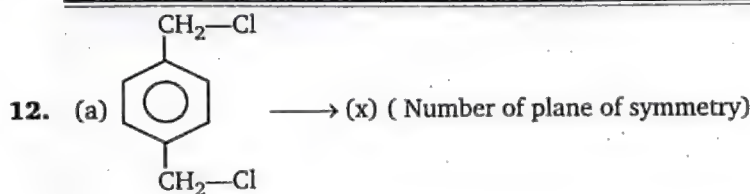
5. Theoretical possible geometrical isomer of



6. Total number of possible structural isomers of  $C_5H_{11}Br$ .  
 7. Total number of plane of symmetry present in given compound is



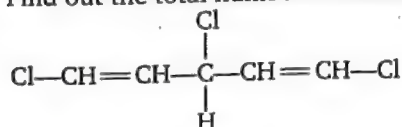
8. Total number of isomers for  $C_4H_6Br_2$  containing cyclobutane ring are ( including stereoisomer) ?  
 9. Total number of structural isomers of  $C_9H_{18}$  containing cyclohexane ring.  
 10. How many structural isomer are possible for  $C_4H_{10}O$  (only alcohol).  
 11. Number of structural isomer of  $C_6H_{14}$  is .



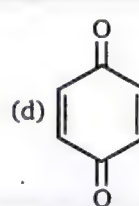
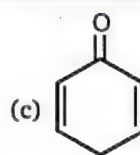
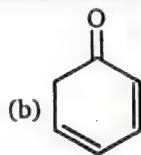
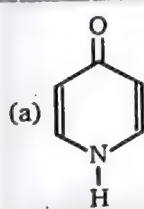
Sum of  $(x+y=?)$

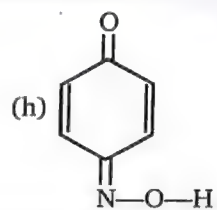
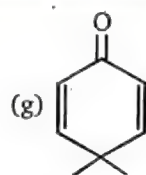
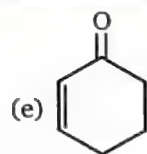
13. Find out the total number of stereocentre in the given compound.  
 $CH_3-CH=CH-\underset{\text{Br}}{\underset{|}{CH}}-\underset{\text{Cl}}{\underset{|}{CH}}-CH_3$

14. Find out the total number of stereoisomers of the given following compound.



15. Find the total number of isomers of  $C_7H_{14}$  (only 5-membered ring).  
 16.  $x$  = number of compounds which undergoes Tautomerisation to form an Aromatic product.





17. If molecule is pyramidal, **X** stereoisomers are possible for :

**C<sub>abcd</sub>**

find the value of **X**.

## ANSWERS — LEVEL 2

1. a - q; b - p; c - r; d - s
2. a - s; b - r; c - q; d - p
3. a - p, s; b - q, r, s; c - q, r, s; d - p, s
4. a - p, q; b - p, q; c - p, q; d - p, r
5. a - r; b - r; c - p; d - s
6. a - p, r; b - q, s; c - q, r; d - p, s
7. a - q, r; b - q, s; c - p, q, r; d - q, s
8. a - r, s; b - p, q; c - r, s; d - p, r, s
9. a - q; b - q, s; c - p, q, s; d - q, s
10. a - p; b - q; c - s; d - r
11. a - p; b - q; c - r; d - s
12. a - q, r; b - p; c - p; d - q, r
13. a - r; b - s; c - r; d - p
14. a - s; b - r; c - q; d - p
15. a - q, r; b - r, s; c - q, r; d - p, q
16. (a - p - x); (b - q, r - y); (c - p - x); (d - q, r - w)
17. A - b, h; B - a, g; C - c, e; D - d, f
18. A - d; B - a
19.  $a + b + c + d = 13$
20. A - b, d, e; B - a, c, f, h; C - i, k, p
21. A - e, f, j; B - a, c, d, g, h, i, b; C - None
22.  $w + x + y + z = 12$
23. A - (c & e), (b & d); B - (a & b) or (a & d); C - (a & c) or (a & e), (b & c), (b & e), (c & d) and (d & e)
24. A - (a & c) (b & f); B - (a & d) or (c & d), (a & e) (c & d); C - (d & e)
25. a - True; b - True; c - True; d - False
26. b, e, f, g, h, i
27. A - d, h; B - d; C - f, h; D - h
28.

Compound	A	B	C
I	c	a	a
II	c	b	b
III	c	a	a
IV	c	b	b
V	c	a	a
VI	c	a	a
VII	c	a	a
VIII	e	b	b
IX	e	a	a
X	e	b	b
29. (a) (R) (b) (L)

30A. 1 - N; 2 - Z; 3 - E; 4 - Z; 5 - Z; 6 - E; 7 - N

B. (a) 1 - Z; 2 - E; 3 - E; 4 - Z; 5 - Z; 6 - E (b)  $2^9$  (c) 10

31. 1 - Z; 2 - N; 3 - E

32. (a) A - 10, B - 4, C - 2

(c) A - 4, B - 2, C - 0

(e) A - 5, B - 2, C - 1

(g) A - 4, B - 2, C - 0

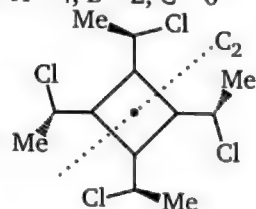
(b) A - 5, B - 0, C - 5

(d) A - 2, B - 1, C - 0

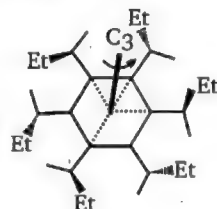
(f) A - 4, B - 1, C - 2

(h) A - 4, B - 1, C - 2

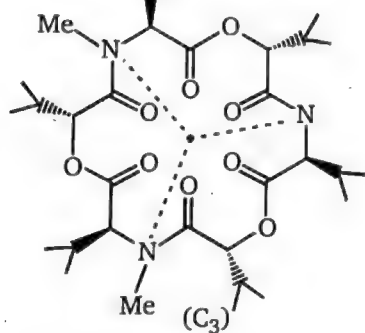
33. (1)



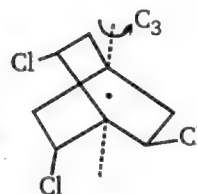
(2)



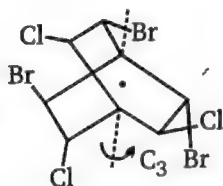
(3)



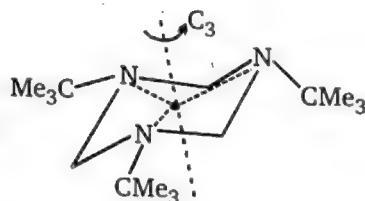
(4)



(5)



(6)



(7)  $C_3$  axis,  $C_2$  axis

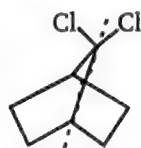
(8)  $C_3$ -axis

(9)  $C_3$  axis

(10)

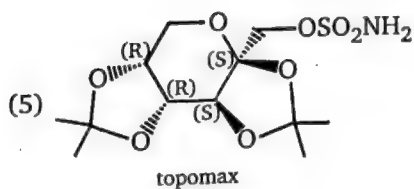
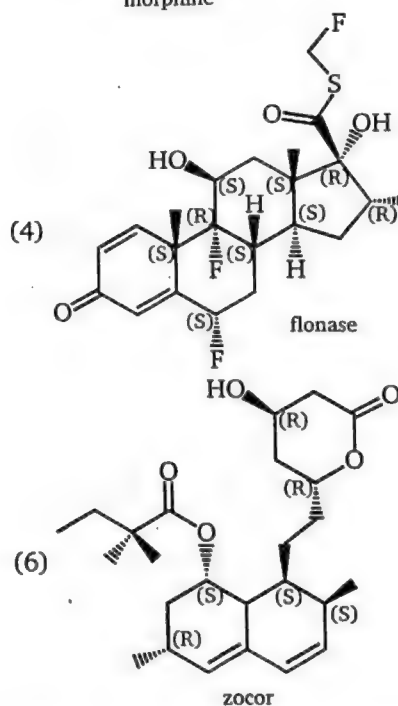
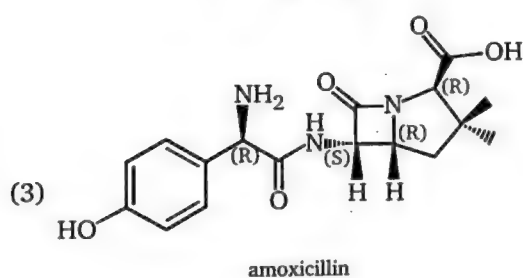
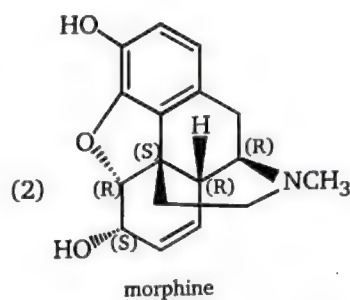
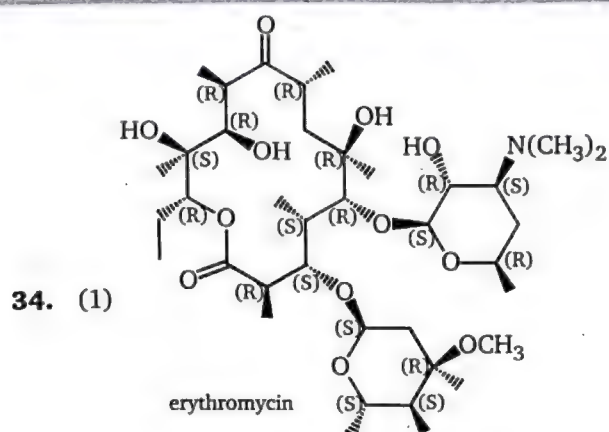


(11)



(12)  $C_2$ -axis

(13)  $C_2$ -axis



35.

Identical Enantiomer Diastereomer Constitutional Isomer



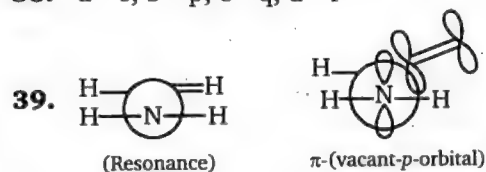


(3)			✓	×	×	×
(4)			✓	×	×	×
(5)			✓	×	×	×
(6)			×	✓	×	×
(7)			×	✓	×	×
(8)			✓	×	×	×
(9)			✓	×	×	×
(10)			×	×	✓	×

36. (A) - (d) (B) - (b)

37. a - p; b - q; c - r; d - s

38. a - s; b - p; c - q; d - r



40. (1) 16 (2) 4 (3) 16 (4) 4 (5) 4  
 (6) 4 (7) 4 (8) 3 (9) 4 (10) 4  
 (11) 2

41. a - 2, b - 4, c - 3, d - 4, e - 8, f - 2

42. a - s; b - p; c - q; d - r

43.  $a - 2^5$ ,  $b - 2^5$ ,  $c - 2^7 + 2^3$ ,  $d - 2^9$

44. A - e; B - b; C - d; D - a

45. A - e; B - c; C - a; D - b; E - d

46. a - p, q, s, t; b - p, r; c - p, q, r, s, t; d - p

### Subjective Problems

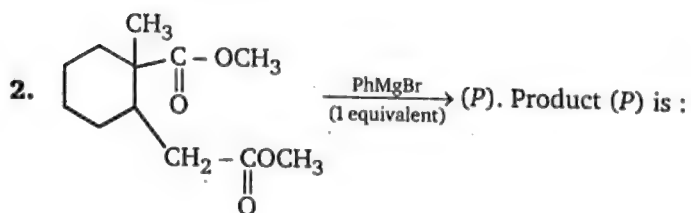
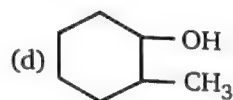
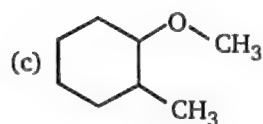
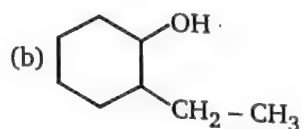
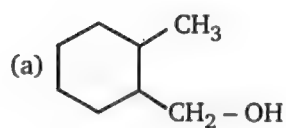
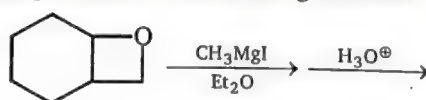
1. 3 (c, f, h) 2. 64 3. 5 4. 5 5. 2 6. 8. 7. 3  
 8. 6 9. 12 10. 4 11. 5 12. 4 13. 4 14. 4 15. 8  
 16. 4 (a, b, c, h) 17. 6

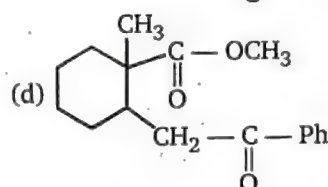
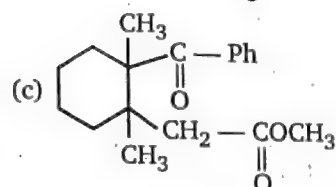
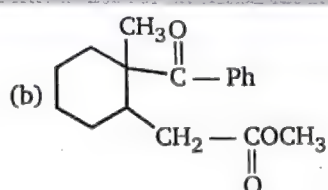
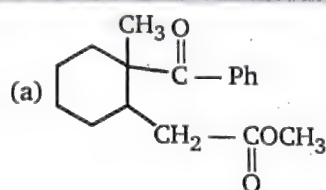
# 3

## GRIGNARD REAGENT

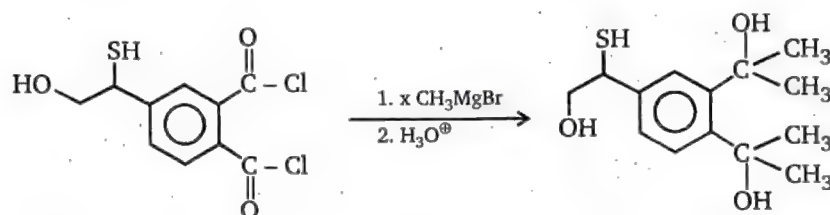
### LEVEL-1

1. What is the major product of the following reaction ?

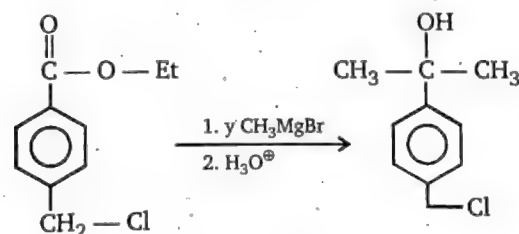




**3. Reaction-1 ;**



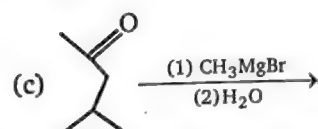
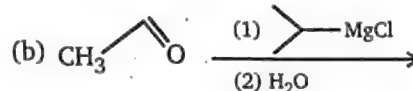
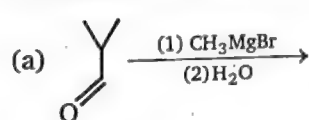
**Reaction-2 ;**



What is the ratio of (x/y) in above problem ?

- (a) 1.5 (b) 2 (c) 2.5 (d) 3

**4. In which of the following reaction 2° alcohol is obtained as a product ?**

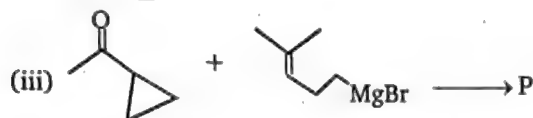
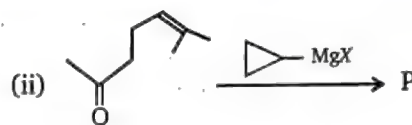
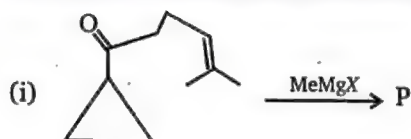


- (d) Both (a) and (b)

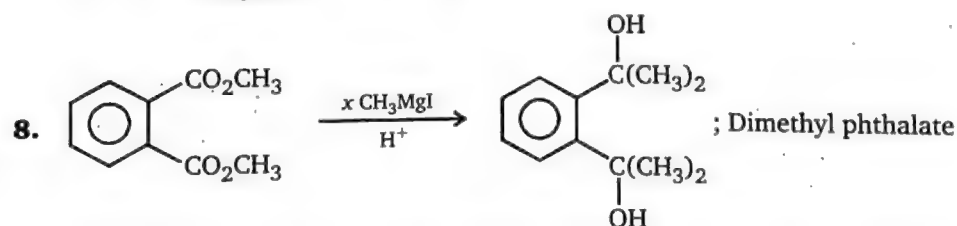
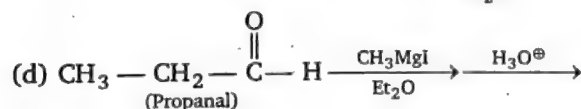
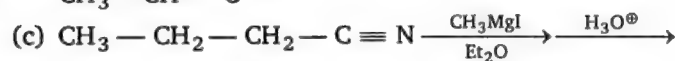
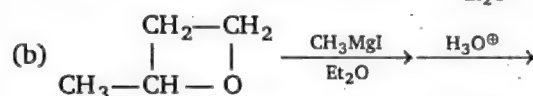
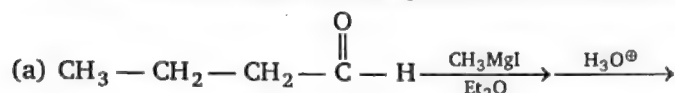
**5. What product would you expect to obtain from Grignard reaction when an excess of phenylmagnesium bromide reacts with dimethyl carbonate  $\text{CH}_3\text{OCOOCH}_3$  ?**

- (a)  $\text{CH}_3 - \text{C}(\text{OH})(\text{Ph})_2$  (b)  $\text{CH}_3 - \text{CH}(\text{OH}) - \text{Ph}$  (c)  $\text{Ph} - \text{C}(\text{OH})(\text{Ph})_2$  (d)  $\text{CH}_3 - \text{C}(=\text{O}) - \text{Ph}$

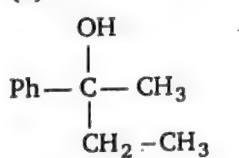
6. In which of the following reactions product formed is same ?



- (a) (i) and (ii)      (b) (ii) and (iii)      (c) (i) and (iii)      (d) (i), (ii) and (iii)
7. Which of the following reaction sequences would be the best for synthesis of 2-pentanone ?

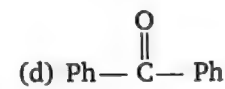
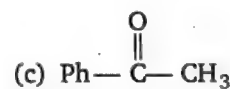
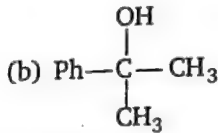
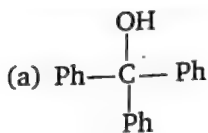
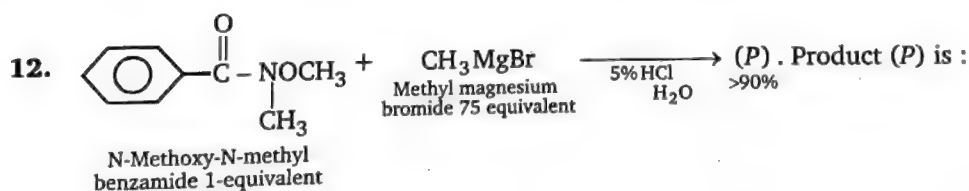
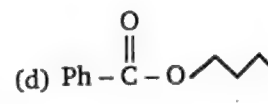
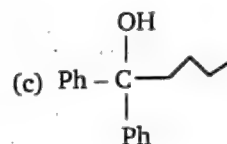
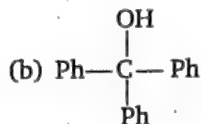
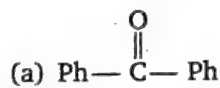
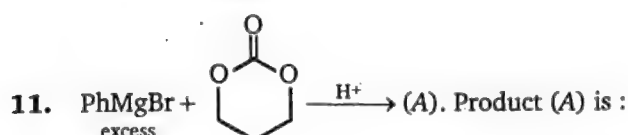
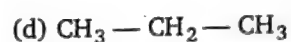
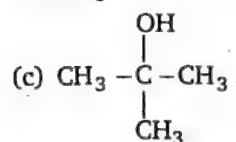
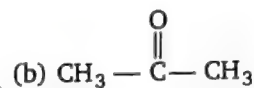
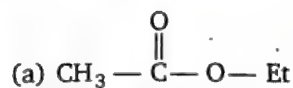
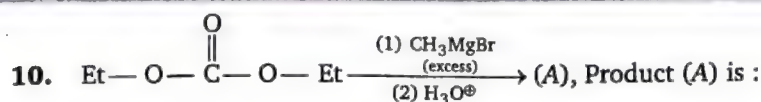


Number of moles (x) of Grignard reagent consumed in the above reaction is :

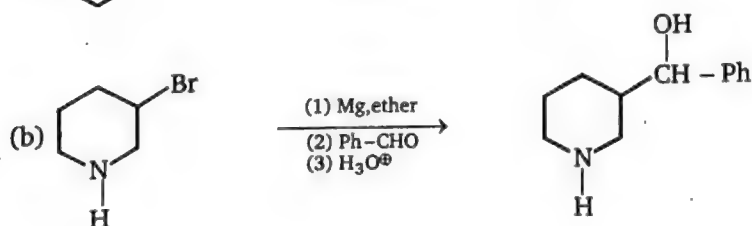
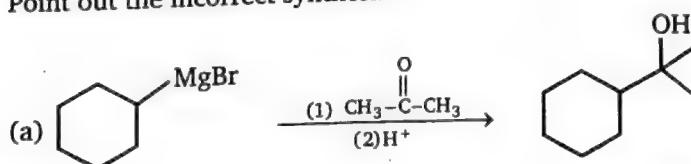
- (a) 2      (b) 3      (c) 4      (d) 5
9. 

Which of the following combinations can not be used to prepare alcohol given above ?

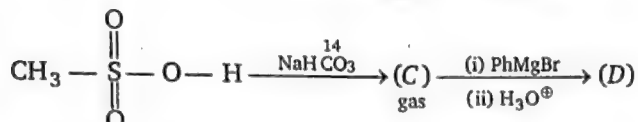
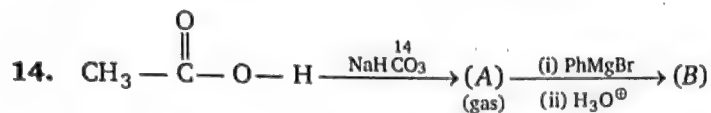
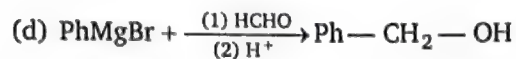
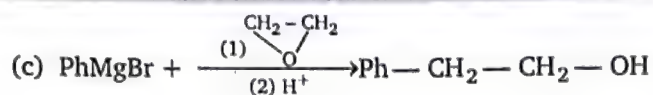
- (a)  $\text{PhMgBr} + \text{2-butanone} \xrightarrow{\text{NH}_4\text{Cl}}$       (b)  $\text{EtMgBr} + \text{Ph} - \overset{\text{O}}{\parallel} \text{C} - \text{CH}_3 \xrightarrow{\text{NH}_4\text{Cl}}$
- (c)  $\text{CH}_3\text{MgBr} + \text{Ph} - \overset{\text{O}}{\parallel} \text{C} - \text{Et} \xrightarrow{\text{NH}_4\text{Cl}}$       (d)  $\text{EtMgBr} + \text{Ph} - \overset{\text{O}}{\parallel} \text{C} - \text{CH}_2 - \text{CH}_3 \xrightarrow{\text{NH}_4\text{Cl}}$



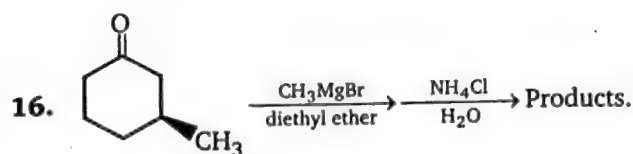
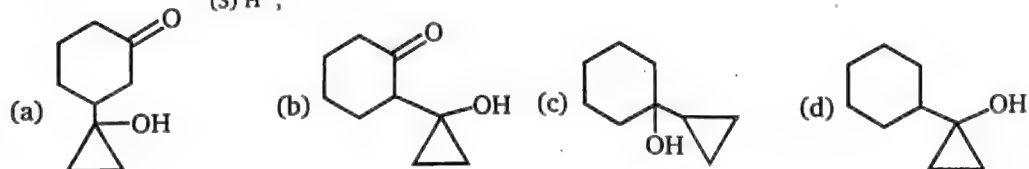
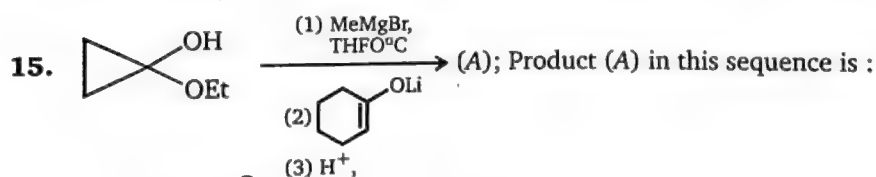
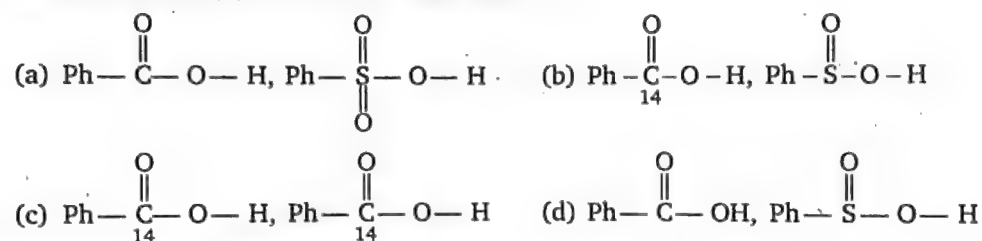
13. Point out the incorrect synthesis :







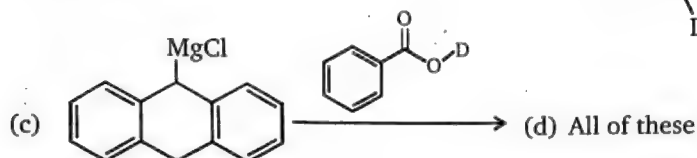
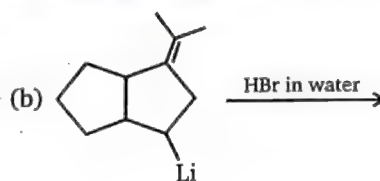
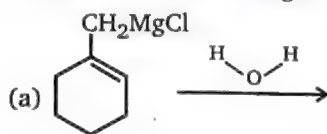
Product (B) and (D) in the above reaction are :



Comment on optical activity of the products. They are ;

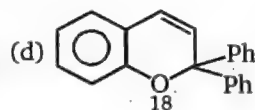
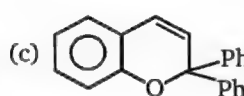
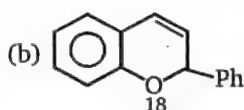
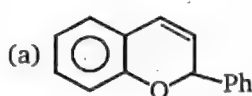
- (a) racemic mixture      (b) diastereomers  
(c) meso forms      (d) optically inactive due to absence of chiral centre

17. In which of the following reaction an acid-base reaction takes place ?

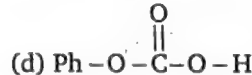
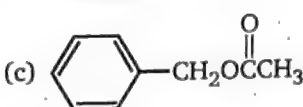
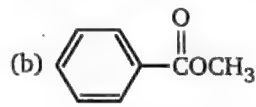
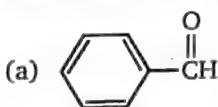


(d) All of these

- 18.



19. All of the following compounds react with ethylmagnesium bromide. Alcohols are formed from three of the compounds. Which one does not give an alcohol ?



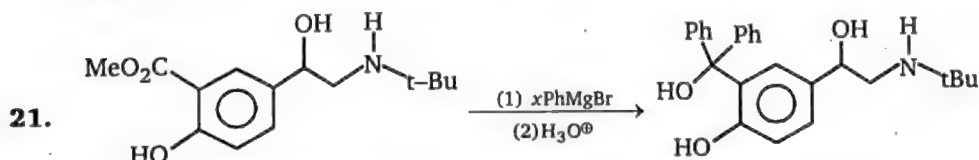
20. A student was carrying out a Grignard reaction between  $\text{PhMgBr}$  and ethyl benzoate. She ran out of anhydrous ether just after the Grignard reagent was made. Which of the following solvents can still be used to dissolve the ethyl benzoate for its reaction with already formed  $\text{PhMgBr}$  ?

(a) acetone

(b) ethyl acetate

(c) absolute alcohol

(d) benzene



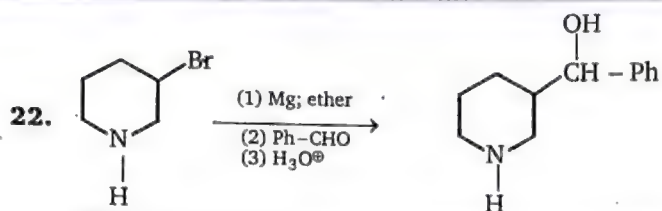
Number of equivalents of Grignard reagent ( $x$ ) used in reaction (1) is :

(a) 3 equivalent

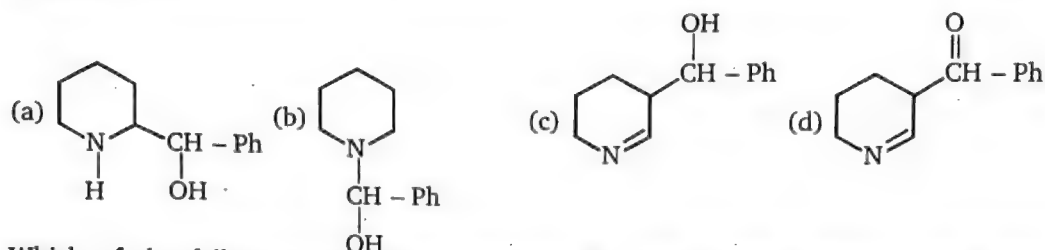
(b) 4 equivalent

(c) 5 equivalent

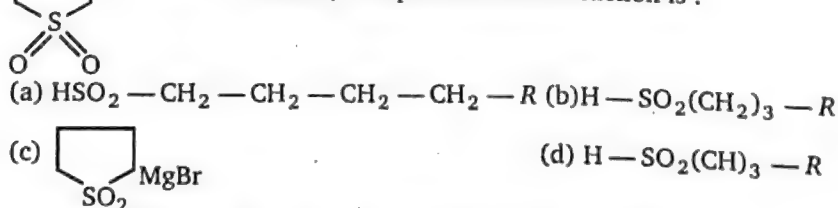
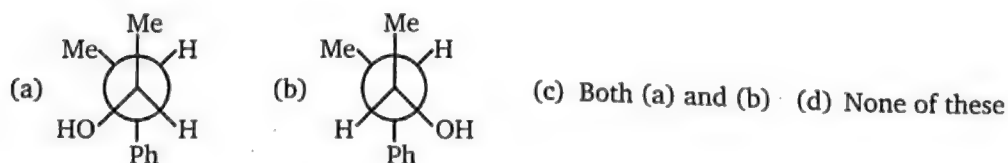
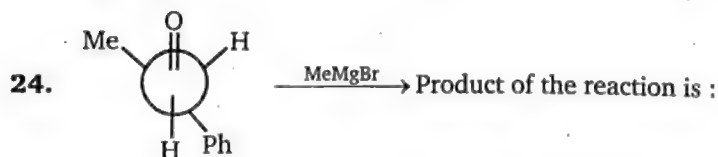
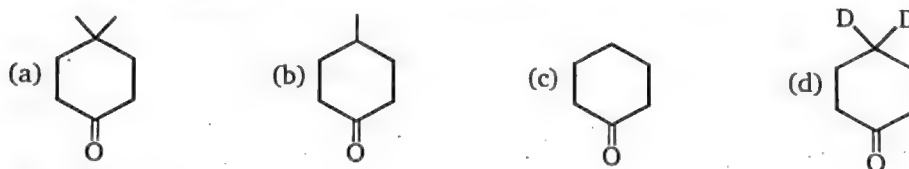
(d) 6 equivalent



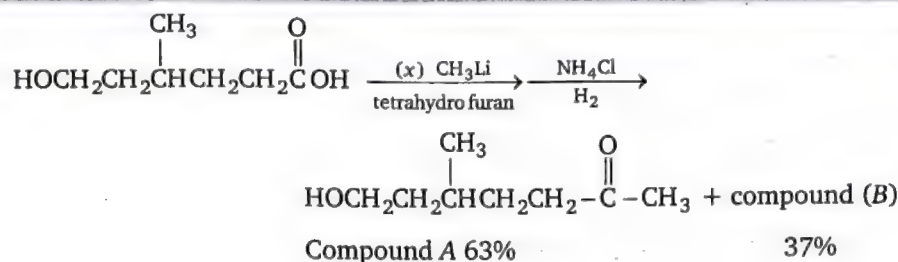
The given product can not be obtained in the above reaction. Identify the correct product obtained.



23. Which of the following gives two isomers of 3° alcohol, when treated with phenyl magnesium bromide?



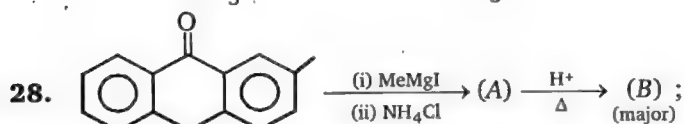
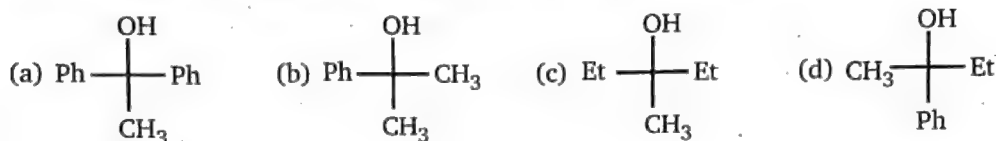
26. When carboxylic acid reacts with organolithium reagents to give ketones, side reaction sometimes occur. For example,



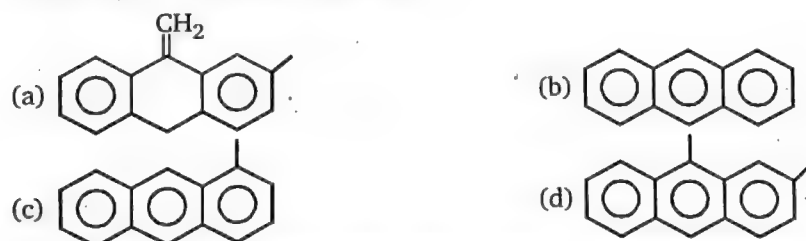
Value of (x) in above reaction is :

- (a) 2 (b) 3 (c) 4 (d) 5

27. Which of the following alcohol can not be prepared by the reaction of acid chloride with excess of Grignard reagent followed by acidification ?

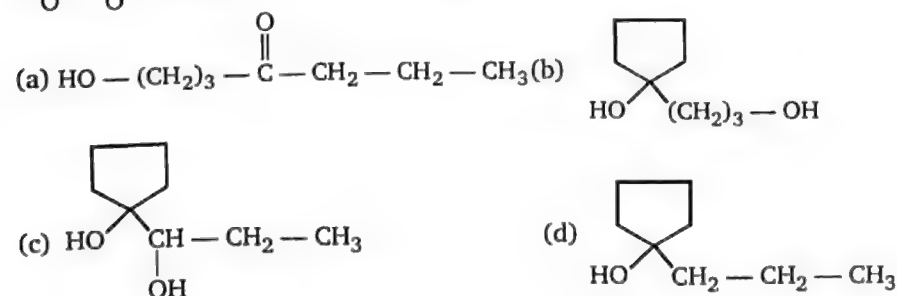
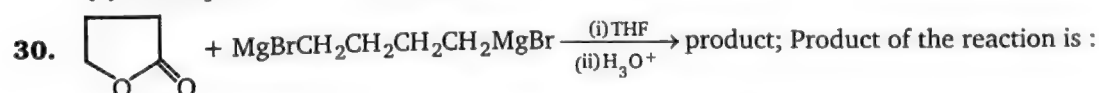


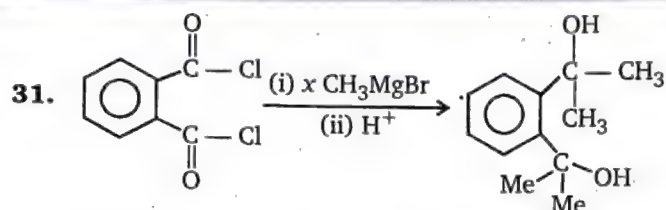
Product (B) of the above reaction is :



29. The reaction of elemental sulphur with Grignard reagent followed by acidification leads to the formation of

- (a) mercaptan (b) sulphoxide (c) thioether (d) sulphonic acid

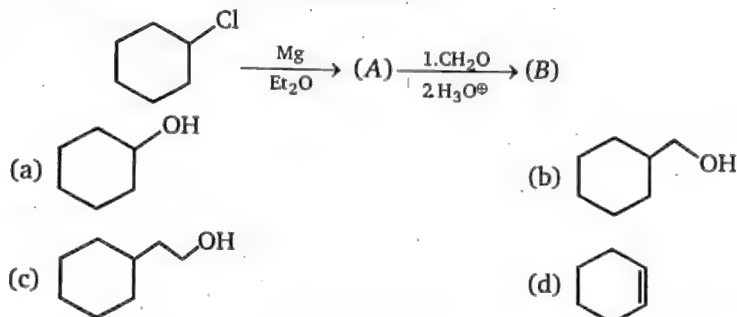




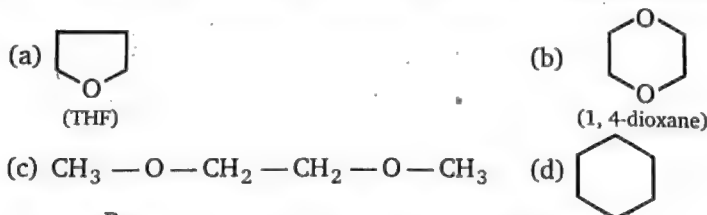
Number of moles of  $\text{CH}_3\text{MgBr}$  consumed in above reaction is :

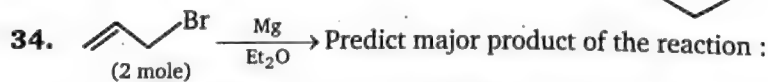
- (a) 2 (b) 4 (c) 6 (d) 8

32. End product of the given reaction is :



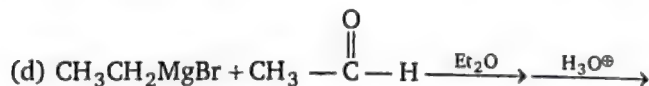
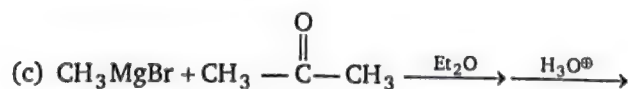
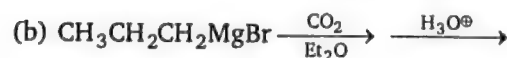
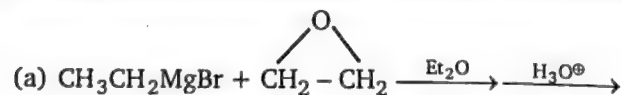
33. Which of the following compound is not a suitable solvent for Grignard reaction ?



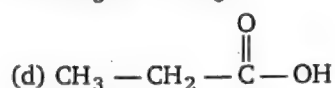
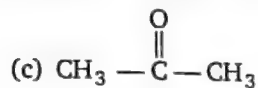
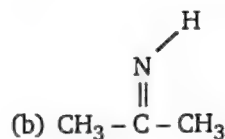
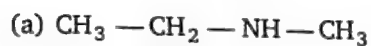
34.  Predict major product of the reaction :



35. Which of the following reaction sequences would be the best for synthesis of t-butyl alcohol ?



36. What is the major product of the following reaction ?



37.  $\text{H} - \text{C}(\text{O}) - \text{CH}_3 \xrightarrow[(2) \text{H}^+]{(1) \text{PhMgBr}}$  Products; Product obtained in this reaction are :

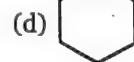
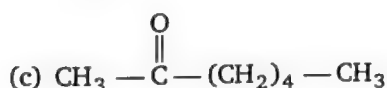
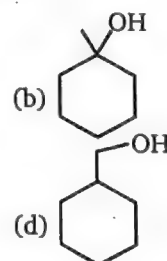
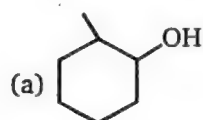
(a) diastereomers

(b) racemic

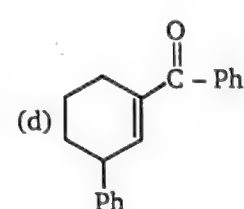
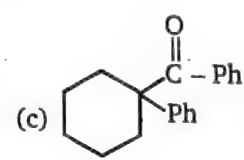
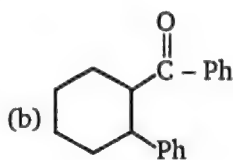
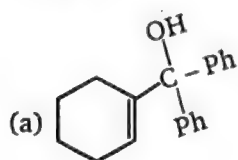
(c) pure enantiomer

(d) meso

38.  $\text{CH}_3\text{CO}_2\text{Et} + (\text{CH}_2)_5(\text{MgBr})_2 \xrightarrow[(2) \text{H}^+]{(A)} \text{C}_7\text{H}_{14}\text{O}$ ; compound (A) will be :

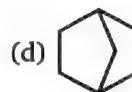
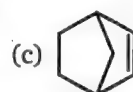
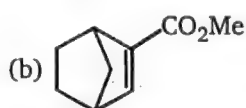
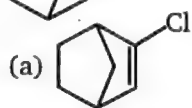
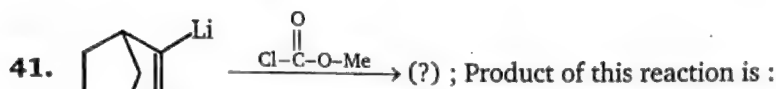
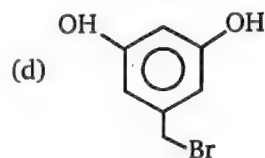
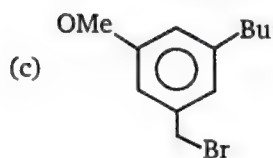
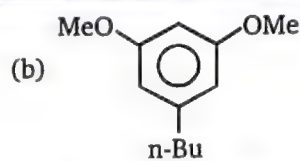
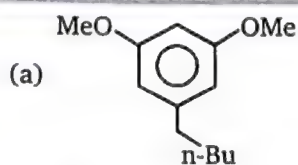


39.  $\xrightarrow[(2) \text{H}^+]{(1) \text{PhMgBr/CuCl}}$  (A) ; A will be :  $\text{C}_{19}\text{H}_{20}\text{O}$

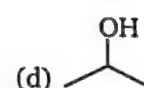
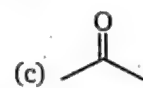
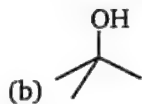
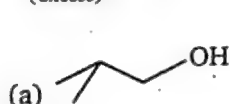
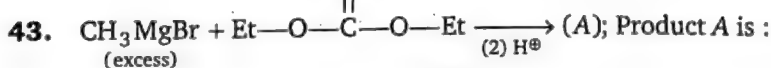
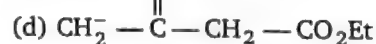
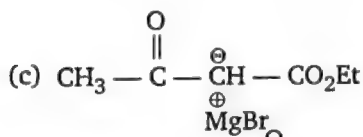
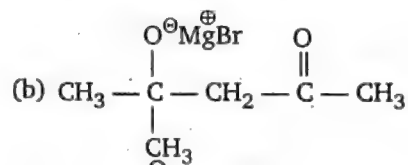
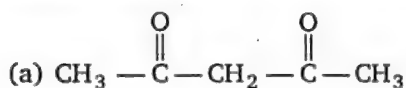


40.  $\xrightarrow[(n\text{-Bu} = n\text{-butyl group})]{n\text{-Bu}_2\text{CuLi}}$  Product of the reaction will be :

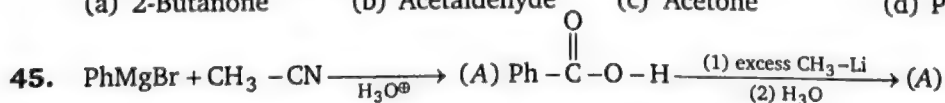
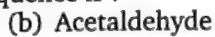
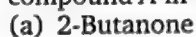




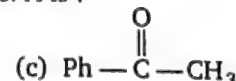
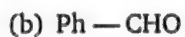
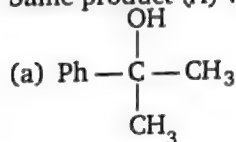
42. Ethyl acetoacetate when reacts with one mole methyl magnesium iodide then product of reaction will be :



44. For the sequence of reactions,  $A \xrightarrow[\text{ether}]{\text{C}_2\text{H}_5\text{MgI}} B \xrightarrow{\text{H}_2\text{O}/\text{H}^+} \text{tert-Pentyl alcohol}$ . The compound A in the sequence is :



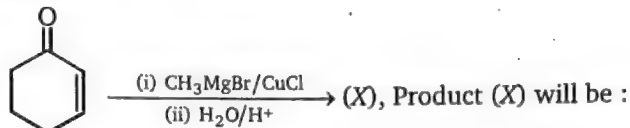
Same product (A) will form in both reactions. A is :



46. Which of the following Grignard reagent can be prepared ?

- (a)  $\text{Br}-\text{Mg}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{O}-\text{H}$  (b)  $\text{Br}-\text{Mg}-\text{CH}_2-\text{CH}_2-\text{SH}$   
 (c)  $\text{BrMg}-\text{CH}_2-\text{CH}_2-\text{NH}_2$  (d)  $\text{BrMg}-\text{CH}_2-\text{CH}_2-\text{N}(\text{CH}_3)_2$

47. In the reaction sequence :



- (a) (b) (c) (d)

48.  $(\text{C}_2\text{H}_5\text{O})_2\text{CO} \xrightarrow[\text{H}_3\text{O}^+]{\text{CH}_3\text{MgBr}(\text{excess})} \text{A}$ . A (alcohol) can also be obtained by :

- (a)  $\text{CH}_3\text{CH}_2\text{CHO} \xrightarrow[\text{H}_3\text{O}^+]{\text{CH}_3\text{MgBr}(2\text{mol})}$  (b)  $\text{CH}_3\text{C}(=\text{O})\text{OC}_2\text{H}_5 \xrightarrow[\text{H}_3\text{O}^+]{\text{CH}_3\text{MgBr}(2\text{mol})}$   
 (c)  $\text{CH}_3\text{C}(=\text{O})\text{CH}_3 \xrightarrow[\text{H}_3\text{O}^+]{\text{CH}_3\text{MgBr}(1\text{mol})}$  (d) as in (b) and (c)

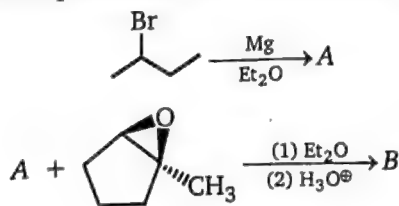
49. The principal product of the reaction between methyl butanoate and 2 moles of  $\text{CH}_3\text{MgBr}$  after hydrolysis is :

- (a)  $\text{C}_3\text{H}_7\text{COCH}_3$  (b)  $\text{C}_3\text{H}_7\text{C}(\text{OH})(\text{CH}_3)_2$   
 (c)  $\text{C}_3\text{H}_7\text{CHOHCH}_3$  (d)  $\text{C}_3\text{H}_7\text{COCH}(\text{CH}_3)_2$

50. Which of the following compounds will form hydrocarbon on reaction with Grignard reagent ?

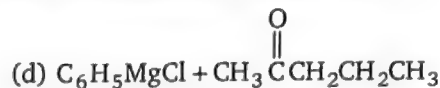
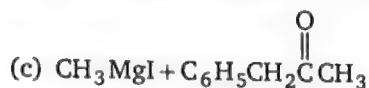
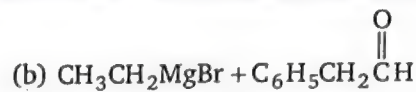
- (a)  $\text{CH}_3\text{CH}_2\text{OH}$  (b)  $\text{CH}_3\text{CHO}$  (c)  $\text{CH}_3\text{COCH}_3$  (d)  $\text{CH}_3\text{CO}_2\text{CH}_3$

51. What is the product (B) of the following reaction sequence ?

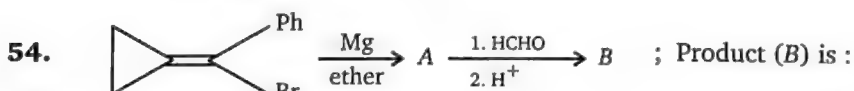
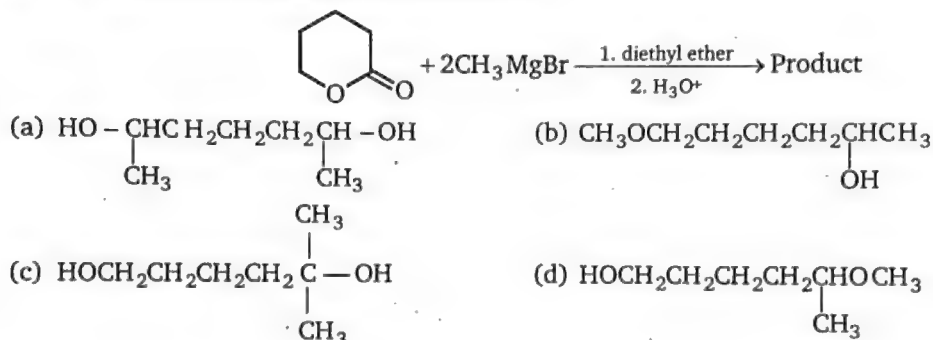



- (a) (b) (c) (d)

52. Which, if any, of the following pairs of reagents could be used to prepare 2-phenyl-2-butanol?



53. What is the product of the following reaction?



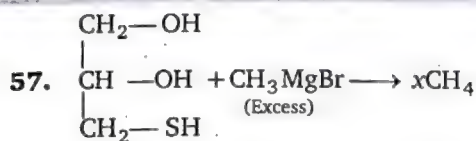
- (a) 
- (b)  $\text{Ph}-\text{C}\equiv\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{OH}$
- (c)  $\text{Ph}-\text{C}\equiv\text{C}-\text{CH}_2-\text{CH}_2-\text{OH}$
- (d)  $\text{Ph}-\text{CH}_2-\text{C}\equiv\text{C}-\text{CH}_2-\text{CH}_2-\text{OH}$

55. What sequence of steps represents the best synthesis of 4-heptanol ( $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CHOH}$ )?

- (a)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{MgBr}$  (2 moles) + formaldehyde ( $\text{H}_2\text{C}=\text{O}$ ) in diethyl ether followed by  $\text{H}_3\text{O}^+$
- (b)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{MgBr}$  + butanal ( $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ ) in diethyl ether followed by  $\text{H}_3\text{O}^+$
- (c)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{MgBr}$  + acetone [ $(\text{CH}_3)_2\text{C}=\text{O}$ ] in diethyl ether followed by  $\text{H}_3\text{O}^+$
- (d)  $(\text{CH}_3\text{CH}_2\text{CH}_2)_2\text{CHMgBr}$  + formaldehyde ( $\text{H}_2\text{C}=\text{O}$ ) in diethyl ether followed by  $\text{H}_3\text{O}^+$

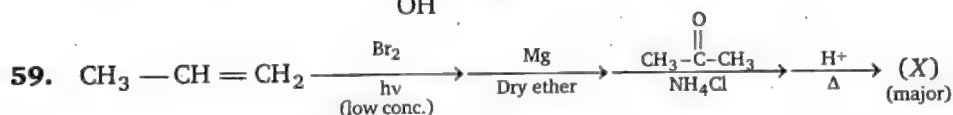


- (a) diastereomers
- (b) racemic
- (c) single stereoisomer
- (d) meso



What is the value of  $x$  in the above reaction ?

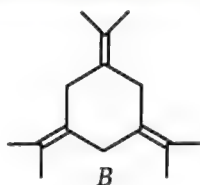
- (a) 1 (b) 2  
(c) 3 (d) 4
58. 0.40 g of an organic compound (A), (M.F.-  $\text{C}_5\text{H}_8\text{O}$ ) reacts with  $x$  mole of  $\text{CH}_3\text{MgBr}$  to liberate 224 mL of a gas at STP. With excess of  $\text{H}_2$ , (A) gives pentan-1-ol. The correct structure of (A) is :
- (a)  $\text{CH}_3\text{—C}\equiv\text{C—CH}_2\text{—CH}_2\text{—OH}$   
 (b)  $\text{CH}_3\text{—CH}_2\text{—C}\equiv\text{C—CH}_2\text{—OH}$   
 (c)  $\text{H—C}\equiv\text{C—CH}_2\text{—CH}_2\text{—CH}_2\text{—OH}$   
 (d)  $\text{H—C}\equiv\text{C—CH}_2\text{—}\underset{\text{OH}}{\text{CH}}\text{—CH}_3$



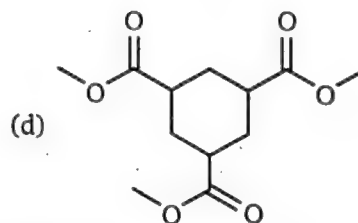
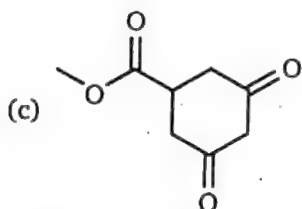
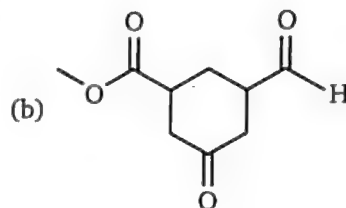
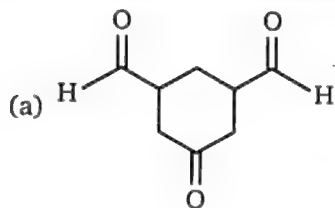
End product (X) of the above reaction is :

- (a)  $\text{CH}_2=\text{CH—CH}_2\text{—}\overset{\text{CH}_2}{\parallel}\text{C—CH}_3$   
 (b)  $\text{H}_2\text{C=CH—CH=}\underset{\text{CH}_3}{\text{C}}\text{—CH}_3$   
 (c)  $\text{H}_2\text{C=CH—CH}_2\text{—}\underset{\text{CH}_3}{\overset{\text{OH}}{\text{C}}}\text{—CH}_3$   
 (d)  $\text{H}_2\text{C=CH—CH}_2\text{—}\underset{\text{CH}_3}{\text{CH}}\text{—CH}_2\text{—OH}$
60. 
$$\text{CH}_2\text{—CH—CH}_2\text{—Br} \xrightarrow[\text{dry ethane}]{\text{Mg}} (\text{A}) \xrightarrow{\text{CH}_3\text{I}} (\text{B}); \text{ Product (B) is :}$$
- (a)  $\text{CH}_2\text{—CH—CH}_2\text{—CH}_3$  (b)  $\text{CH}_3\text{—O—CH}_2\text{—CH}_2\text{—CH}_3$   
 (c)  $\text{H}_2\text{C=CH—CH}_2\text{—O—CH}_3$  (d)  $\text{H}_2\text{C—CH—CH}_3$

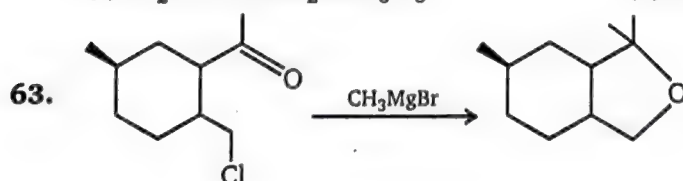
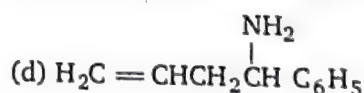
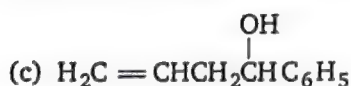
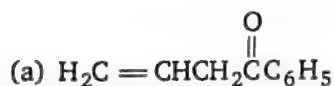
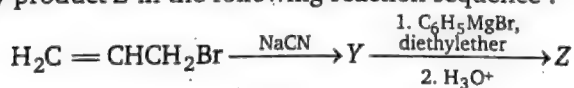
61. Compound A was treated with a large excess of  $\text{CH}_3\text{MgBr}$ . The resulting product was exposed to  $\text{POCl}_3/\text{pyridine}$  to give compound B, as one of many products:



Which of the following compounds can be A ?



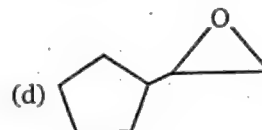
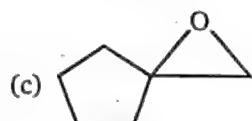
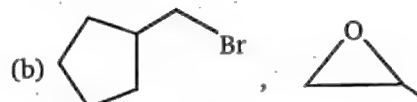
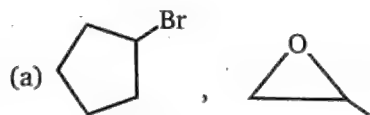
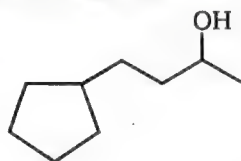
62. Identify product Z in the following reaction sequence :



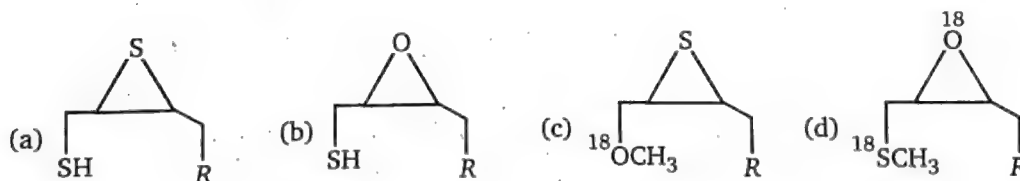
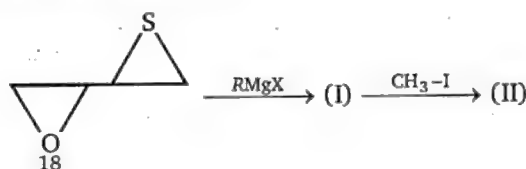
(Consider all steps and intermediate) correct statement is :

- (a) Nucleophilic addition                      (b) Nucleophilic substitution reaction  
(c) Product obtained is chiral              (d) All

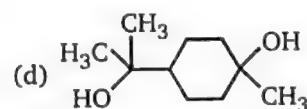
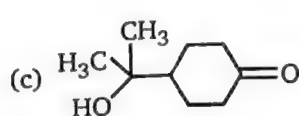
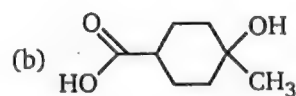
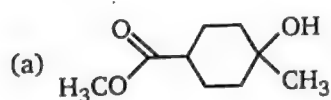
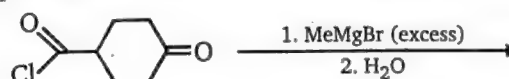
64. Which combination(s) of alkyl bromide and epoxide can be used to prepare the following product by addition of the Grignard reagent derived from the alkyl bromide to the epoxide?



65. What will be the final major product?



66. Give the expected product of the following reaction.



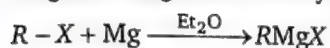


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## 1. Comprehension

Grignard reagent is usually prepared by



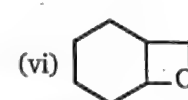
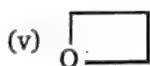
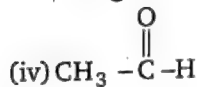
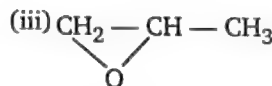
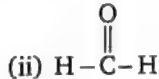
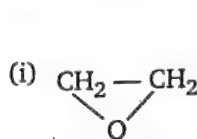
Grignard reagent



Grignard reagent

Grignard reagent acts as a strong base. Grignard reagent carry out nucleophilic attack in absence of acidic hydrogen. Grignard reagent form complex with its ether solvent. Complex formation with molecule of ether is an important factor in the formation and stability of Grignard reagent.

- A.** What is the correct order of reactivity of halides with magnesium ?
- (a)  $R-Cl > R-Br > R-I$  (b)  $R-Br > R-Cl > R-I$   
 (c)  $R-I > R-Br > R-Cl$  (d)  $R-I = R-Br = R-Cl$
- B.** Which of the following will undergo acid-base reaction with Grignard reagent ?
- (a)  $HC \equiv CH$  (b)  $R-OH$   
 (c)  $R-CO_2H$  (d) All of these
- C.** Which of the following reactants give primary alcohol as a major product when reacts with  $RMgX$  followed by acidification ?

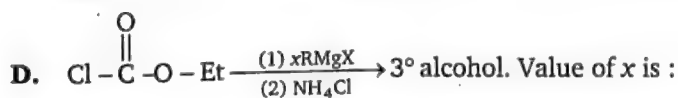


(a) i, ii, v

(b) i, ii, v, vi

(c) ii, iv, vi

(d) v, iv, iii, vi

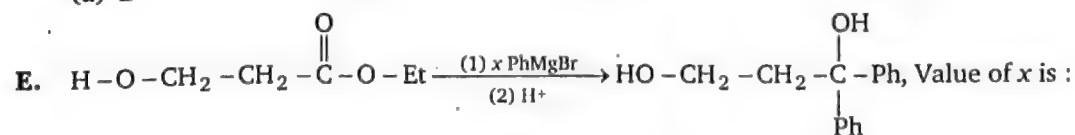


(a) 2

(b) 3

(c) 4

(d) 5



(a) 2

(b) 3

(c) 4

(d) 5

- F. Which of the following Grignard reagents is not possible ?  
 (a)  $\text{HS}-\text{CH}_2-\text{CH}_2-\text{CH}_2\text{MgBr}$  (b)  $\text{HO}-\text{CH}_2-\text{CH}_2-\text{CH}_2\text{MgBr}$   
 (c)  $\text{NH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2\text{MgBr}$  (d) All of these
- G. How many different Grignard reagents when react with EtOH, give *n*-butane as product (excluding stereoisomerism).  
 (a) 1 (b) 2 (c) 3 (d) 4
2. Match the column I and II. (Matrix)

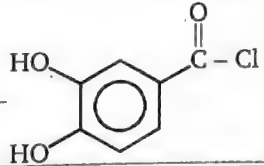
Column (I)		Column (II)	
Reactant		Product	
(a)	$\text{PhMgBr} + \text{Cl}-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{Et} \xrightarrow{\text{H}^+}$ (excess)	(p)	$\text{Ph}-\text{CH}_2-\text{OH}$
(b)	$\text{PhMgBr} + \text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{Et} \xrightarrow{\text{H}^+}$ (excess)	(q)	$\begin{array}{c} \text{Ph}-\text{CH}-\text{Ph} \\   \\ \text{OH} \end{array}$
(c)	$\text{PhMgBr} + \text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H} \xrightarrow{\text{H}^+}$ (excess)	(r)	$\begin{array}{c} \text{OH} \\   \\ \text{Ph}-\text{C}-\text{Ph} \\   \\ \text{Ph} \end{array}$
(d)	$\text{PhMgBr} + \text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{Et} \xrightarrow{\text{H}^+}$ (excess)	(s)	$\begin{array}{c} \text{OH} \\   \\ \text{Ph}-\text{C}-\text{Ph} \\   \\ \text{CH}_3 \end{array}$

3. Match the column I and II. (Matrix)

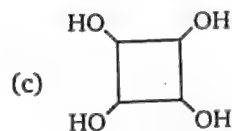
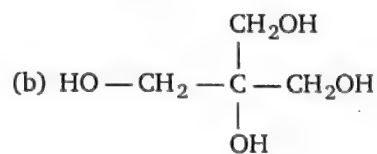
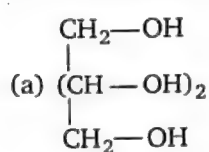
Column (I)		Column (II)	
Reaction		Reactant	
(a)	$\text{PhMgBr} + (\text{A}) \xrightarrow{\text{H}^+} 1^\circ\text{alcohol}$	(p)	$\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$
(b)	$\text{PhMgBr} + (\text{B}) \xrightarrow{\text{H}^+} 2^\circ\text{alcohol}$	(q)	$\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$
(c)	$\text{PhMgBr} + (\text{C}) \xrightarrow{\text{H}^+} 3^\circ\text{alcohol}$	(r)	$\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$
(d)	$\text{PhMgBr} + (\text{D}) \xrightarrow{\text{H}^+} \text{C}_6\text{H}_6$	(s)	$\text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$

Match the missing reactant A, B, C, D

4. Match the column I and II. (Matrix)

Column (I)		Column (II)	
Reaction		Moles of PhMgBr used	
(a)	$\text{PhMgBr} + \text{Et}-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{Et} \xrightarrow{\text{H}^+} 3^\circ\text{alcohol}$	(p)	1
(b)	$\text{PhMgBr} + \text{HO}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3 \xrightarrow{\text{H}^+} 3^\circ\text{alcohol}$	(q)	2
(c)	$\text{PhMgBr} + \text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3 \xrightarrow{\text{H}^+} 3^\circ\text{alcohol}$	(r)	3
(d)	$\text{PhMgBr} + $  $\xrightarrow{\text{H}^+} 3^\circ\text{alcohol}$	(s)	4

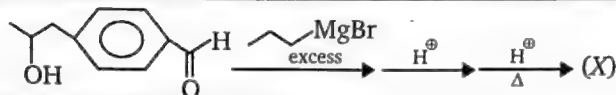
5. When 20 g of a compound (A) (M.F. =  $\text{C}_4\text{H}_{10}\text{O}_4$ ) reacts with excess of  $\text{CH}_3\text{MgBr}$ , 14.6 L of  $\text{CH}_4$  is obtained at STP. What is structural formula of (A) ?



(d) Both (a) & (b)

## SUBJECTIVE PROBLEMS

1.



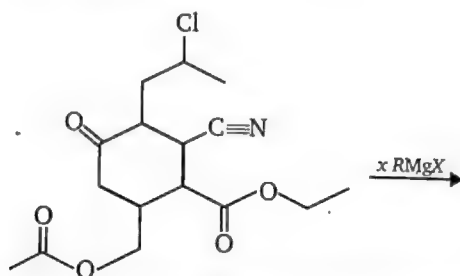
How many geometrical isomer of (X) is possible ?

2. How many isomer of  $C_4H_8O$  when reacts with  $CH_3MgBr$  followed by acidification to give  $2^\circ$  alcohol (only consider carbonyl isomers)?

(including stereoisomer)

3.

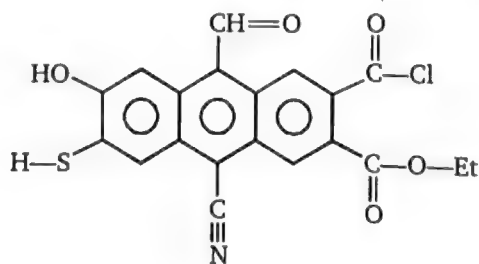
Total number of  $RMgX$  are consumed in the following reaction



4. How many isomers of  $C_4H_{10}O$  reacts with  $CH_3MgBr$  to evolve  $CH_4$  gas ? ( Excluding stereoisomer)

5. How many carbonyl isomers of  $C_5H_{10}O$  which reacts with  $PhMgBr$  to give racemic mixture ?

6. How many moles of Grignard reagent will consume when it reacts with following compound?





**ANSWERS — LEVEL 2**

1. A - c; B - d; C - a; D - b; E - b; F - d; G - b
2. a - r; b - q; c - p; d - s
3. a - s; b - r; c - q; d - p
4. a - r; b - q; c - p; d - s
5. (d)

## Subjective Problems

2. 2

3. 7

#### 4. 4

## 5. 5

6. 8

## HYDROCARBONS (ALKANES)

# LEVEL-1

- On halogenation, an alkane gives only one monohalogenated product. The alkane may be :
  - 2-methyl butane
  - 2, 2-dimethyl propane
  - cyclopentane
  - both (b) and (c)
- Which of the following compounds can be best prepared by Wurtz-reaction ?
  - Iso-butane
  - n*-butane
  - n*-pentane
  - Iso-pentane
- A hydrocarbon A (V.D. = 36) forms only one monochloro substitution product. A will be :
  - iso-pentane
  - neo-pentane
  - cyclohexane
  - methyl-cyclohexane
- Ethyl iodide and *n*-propyl iodide are allowed to undergo Wurtz reaction. The alkane which will not be obtained in this reaction is :
  - butane
  - propane
  - pentane
  - hexane
- $$\text{CH}_3 - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_2 - \text{CH}_3 \xrightarrow[\text{h}\nu]{\text{Cl}_2}$$

**Number of chiral centers generated during monochlorination in the above reaction :**

- (b) 2

- (c) 3

- (d) 4





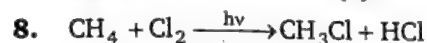
Above conversion can be achieved by :

- (a)  $\text{Zn} / \text{H}^+$  (b)  $\text{LiAlH}_4$   
(c)  $\text{Mg} / (\text{ether})$  then  $\text{H}_2\text{O}$  (d) all of these



Give the total number of monochloro products (including stereoisomers), which are possible in the above reaction.

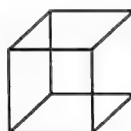
- (a) 2 (b) 3 (c) 4 (d) 5



To obtain high yields of  $\text{CH}_3\text{Cl}$ , the ratio of  $\text{CH}_4$  to  $\text{Cl}_2$  must be :

- (a) high (b) low  
(c) equal (d) can't be predicted

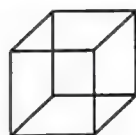
9. Double bond equivalent of cubane is :



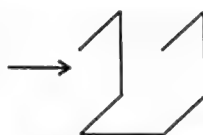
Cubane

- (a) 4 (b) 5 (c) 6 (d) 7

10. How many bond cleavages are required to convert cubane into non-cyclic skeleton ?



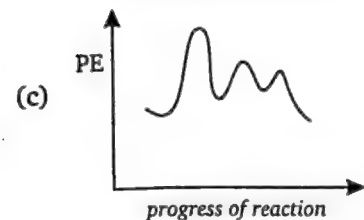
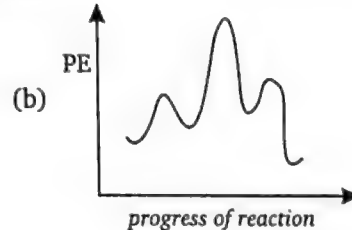
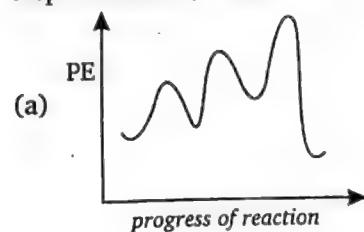
Cubane



Non-cyclic skeleton

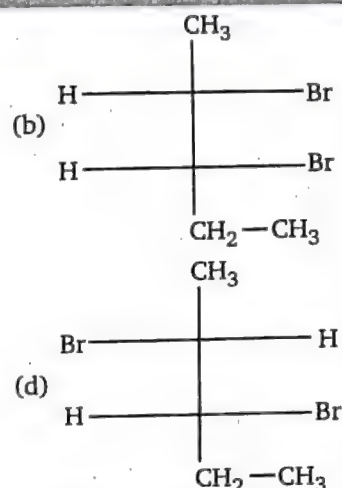
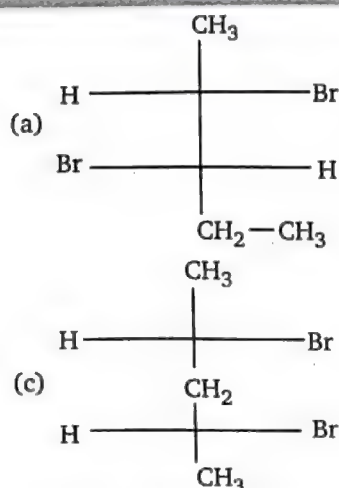
- (a) 2 (b) 3 (c) 4 (d) 5

11. Draw an energy profile diagram for a three step reaction in which first step is slowest and last step is fastest. (Assume that reaction is exothermic)

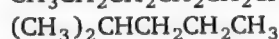
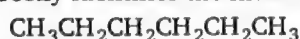


(d) None of these

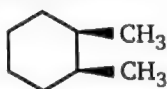




18. Following are the structures of four isomer of hexane. Among the names given below, which correctly identifies the fifth isomer ?




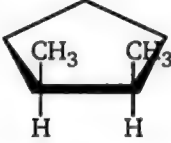
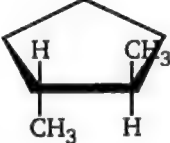
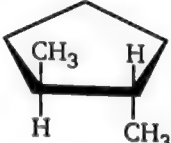


- (a) 2-Methyl pentane  
(b) 2-Ethyl butane  
(c) 2,3-Dimethyl butane  
(d) 3-Methyl pentane
19. Which of the following describes the best relationship between the methyl groups in the chair conformation of the substance shown below ?



- (a) Trans  
(b) Anti  
(c) Gauche  
(d) Eclipsed
20. Compare the stabilities of the following two compounds (A) and (B):  
A : *cis*-1-ethyl-3-methyl cyclohexane      B : *trans*-1-ethyl-3-methyl cyclohexane  
(a) A is more stable  
(b) B is more stable  
(c) A and B are of equal stability  
(d) No comparison can be made
21. Which conformation of ethane has the lowest potential energy ?  
(a) Eclipsed  
(b) Skew  
(c) Staggered  
(d) All will have equal potential energy
22. Ethane is subjected to combustion process. During the combustion the hybrid state of carbon changes from :  
(a)  $sp^2$  to  $sp^3$   
(b)  $sp^3$  to  $sp$   
(c)  $sp$  to  $sp^3$   
(d)  $sp^2$  to  $sp^2$
23. 
$$\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \xrightarrow[\Delta]{\text{AlCl}_3} \text{CH}_3 - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_3$$

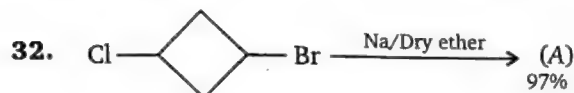
Above reaction is an example of :

- (a) isomerization (b) polymerization  
(c) cracking (d) de-hydrogenation
24. Which of the following has highest chlorine content ?  
(a) Pyrene (b) DDT (c) Chloral (d) Gammaxene
25. Pure methane can be prepared by :  
(a) Wurtz reaction (b) Kolbe electrolysis method  
(c) soda-lime de-carboxylation (d) reduction with  $H_2$
26. Calcium carbide + heavy water  $\longrightarrow$  ?  
The product of the above reaction is :  
(a)  $C_2H_2$  (b)  $CaD_2$  (c)  $Ca(OD)_2$  (d)  $CD_4$
27.  $CH_3-CH_2-$    $CH_3-CH_2-$    $CH_3-CH_2-$    
Ethyl cyclopentane Ethyl cyclohexane Ethyl cycloheptane  
(I) (II) (III)
- Arrange the compounds I, II and III in decreasing order of their heats of combustion:  
(a)  $II > I > III$  (b)  $I > II > III$   
(c)  $III > II > I$  (d)  $III > I > II$
28. An alkane (mol. wt. = 86) on bromination gives only two monobromo derivatives (excluding stereoisomers). The alkane is :  
(a)  $CH_3-\underset{\substack{| \\ CH_3}}{CH}-CH_2-CH_2-CH_3$  (b)  $CH_3-\overset{\substack{CH_3 \\ |}}{\underset{\substack{CH_3 \\ | \\ CH_3}}{C}}-CH_2-CH_3$   
(c)  $CH_3-\underset{\substack{| \\ CH_3}}{CH}-\underset{\substack{| \\ CH_3}}{CH}-CH_3$  (d)  $CH_3-\overset{\substack{CH_3 \\ |}}{\underset{\substack{CH_3 \\ |}}{C}}-CH_3$
29. Order of the bond strength of C — H bonds involving  $sp, sp^2$  and  $sp^3$  hybridized carbon atoms is :  
(a)  $sp > sp^2 > sp^3$  (b)  $sp^3 > sp^2 > sp$   
(c)  $sp^2 > sp^3 > sp$  (d)  $sp^2 > sp > sp^3$
30.  (I)  (II)  (III)
- Among the structures given, select the enantiomers :  
(a) I and II (b) I and III  
(c) II and III (d) I, II and III



The correct order of reactivity of I, II & III towards addition reactions is :

- (a)  $I > III > II$  (b)  $I > II > III$  (c)  $III > II > I$  (d)  $III > I > II$



Product (A) of above reaction is :



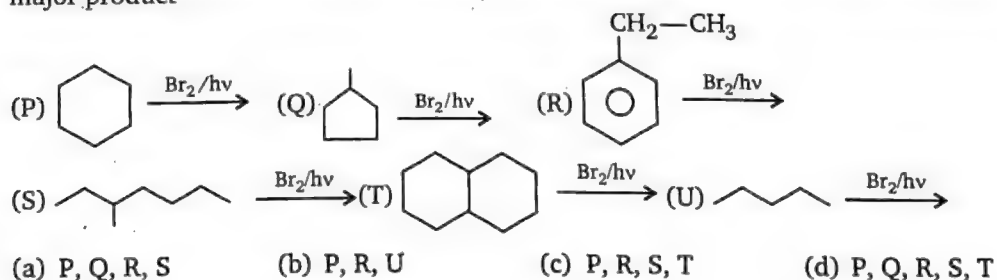
33. Which of the following reactants is suitable for preparation of methane and ethane by using one step only ?

- (a)  $\text{H}_2\text{C} = \text{CH}_2$  (b)  $\text{CH}_3\text{OH}$   
(c)  $\text{CH}_3 - \text{Br}$  (d)  $\text{CH}_3 - \text{CH}_2 - \text{OH}$

34. How many carbon atoms does an alkane (not a cycloalkane) need before it is capable to exist in enantiomeric form ?

- (a) 4 (b) 5 (c) 6 (d) 7

35. Among the following free radical bromination reactions, select those in which  $2^\circ$  halide is the major product —



36. (A) +  $\text{Cl}_2 \xrightarrow{h\nu}$  monochloro product

To maximise the yield of monochloro product in the above reaction ?

- (a)  $\text{Cl}_2$  must be added in excess  
(b) Reactant (A) must be added in excess  
(c) Reaction must be carried out in dark  
(d) Reaction must be carried out with equimolar mixture of  $\text{Cl}_2$  and A

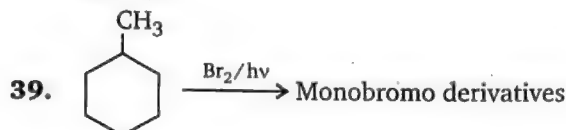
37.  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \xrightarrow{\text{Br}_2/h\nu}$

Major product in the above reaction is :

- (a) Racemic mixture (b) Meso  
(c) Diastereomers (d) Constitutional isomers

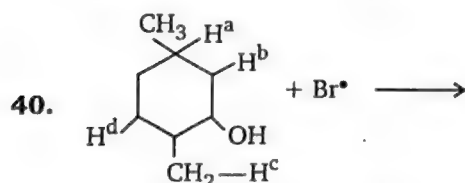
38. Select the chain propagation steps in the free-radical chlorination of methane.

- (1)  $\text{Cl}_2 \longrightarrow 2\text{Cl}^\bullet$  (2)  $\text{Cl}^\bullet + \text{CH}_4 \longrightarrow \text{CH}_3\text{Cl} + \text{H}^\bullet$   
 (3)  $\text{Cl}^\bullet + \text{CH}_4 \longrightarrow \text{CH}_3^\bullet + \text{HCl}$  (4)  $\text{H}^\bullet + \text{Cl}_2 \longrightarrow \text{HCl} + \text{Cl}^\bullet$   
 (5)  $\text{CH}_3^\bullet + \text{Cl}_2 \longrightarrow \text{CH}_3\text{Cl} + \text{Cl}^\bullet$   
 (a) 2, 3, 5 (b) 1, 3, 6  
 (c) 3, 5 (d) 2, 3, 4



The number of possible monobromo products is (excluding stereoisomers):

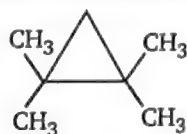
- (a) 4 (b) 5 (c) 8 (d) 10



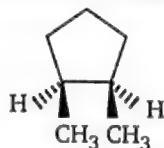
$\text{Br}^\bullet$  will abstract which of the hydrogen most readily?

- (a) a (b) b (c) c (d) d

41. Arrange the following compounds in decreasing order of their heats of combustion :



(i)

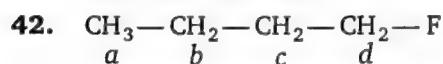


(ii)



(iii)

- (a) (iii) > (ii) > (i) (b) (ii) > (i) > (iii)  
 (c) (iii) > (i) > (ii) (d) (i) > (ii) > (iii)



Arrange the hydrogens a, b, c, d, in decreasing order of their reactivities towards chlorination:

- (a)  $a > b > c > d$  (b)  $b > c > d > a$   
 (c)  $b > c > a > d$  (d)  $c > b > a > d$

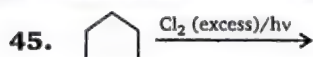
43. On catalytic reduction ( $\text{H}_2/\text{Pt}$ ) how many alkenes will give n-butane?

- (a) 1 (b) 2  
 (c) 3 (d) 4

44. On catalytic reduction ( $\text{H}_2/\text{Pt}$ ) how many alkenes will give 2-methylbutane?

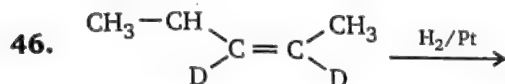
- (a) 1 (b) 2  
 (c) 3 (d) 4





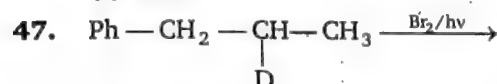
How many dichloro products are formed in the above reaction (including stereoisomers)?

- (a) 5 (b) 6  
(c) 7 (d) 9



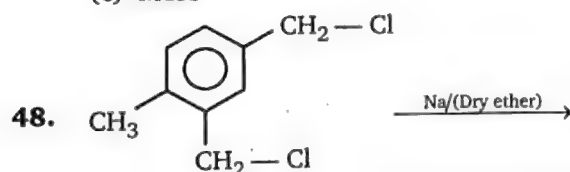
Product of the above reaction will be :

- (a) Racemic mixture (b) Diastereomers  
(c) Meso (d) Constitutional isomers

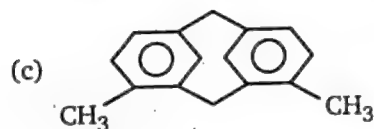
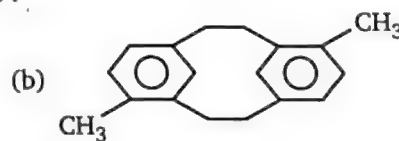
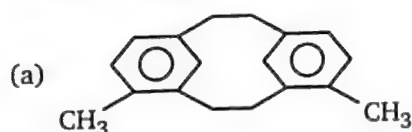


Product of the above reaction will be :

- (a) Diastereomers (b) Racemic mixture  
(c) Meso (d) Constitutional isomers

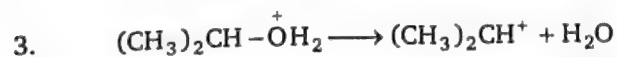
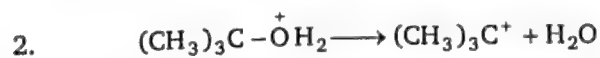
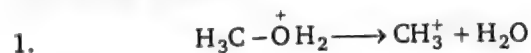


Products obtained in above Wurtz reaction is :



- (d) Both (a) and (b)

49. Rank the transition states that occur during the following reaction steps in order of increasing stability (least  $\rightarrow$  most stable) :



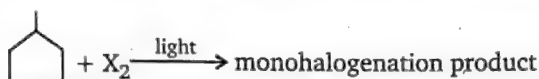
- (a)  $1 < 2 < 3$  (b)  $2 < 3 < 1$   
(c)  $1 < 3 < 2$  (d)  $2 < 1 < 3$



## LEVEL-2

## 1. Comprehension

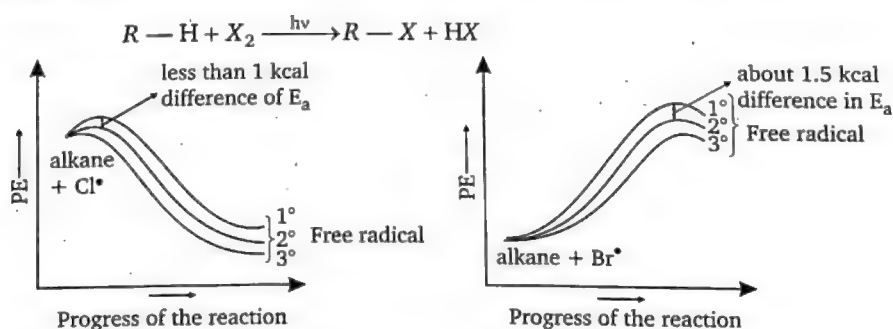
For the given question (1, 2, 3), consider the following reaction.



- A. Light is involved in which step of the reaction :  
 (a) Initiation only (b) Termination only  
 (c) Propagation only (d) Propagation and Termination
- B. Which halogen will give the best yield of a single monohalogenation product ?  
 (a)  $\text{F}_2$  (b)  $\text{Cl}_2$  (c)  $\text{Br}_2$  (d)  $\text{I}_2$
- C. How many monohalo derivatives are possible (excluding stereoisomers) ?  
 (a) 3 (b) 4 (c) 5 (d) 6

## 2. Comprehension

Halogenation is a substitution reaction, where halogen replaces one or more hydrogens of hydrocarbon.



Chlorination is exothermic and transition state resembles with products

Bromination is endothermic and transition state resembles with products

Chlorine free radical make  $1^\circ$ ,  $2^\circ$ ,  $3^\circ$  radicals with almost equal ease, whereas bromine free radicals have a clear preference for the formation of tertiary free radicals. So, bromine is less reactive, and more selective whereas chlorine is less selective and more reactive.

The relative rate of abstraction of hydrogen by  $\text{Br}^\bullet$  is

$$3^\circ > 2^\circ > 1^\circ$$

(1600) (82) (1)

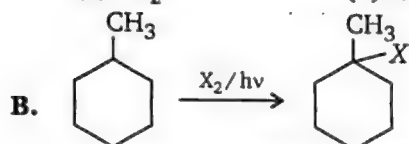
The relative rate of abstraction of hydrogen by  $\text{Cl}^\bullet$  is :

$$3^\circ > 2^\circ > 1^\circ$$

(5) (3.8) (1)

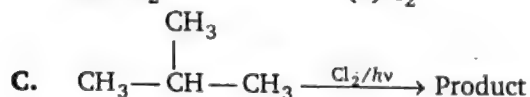
Consider the above argument and answer A to G :

- A. 1-halo-2,3-dimethyl butane will be obtained in better yields, if halogen is :  
 (a)  $\text{Br}_2$  (b)  $\text{Cl}_2$  (c)  $\text{I}_2$  (d) Can't be predicted



Above product will obtained in better yield if X is

- (a)  $\text{Cl}_2$  (b)  $\text{I}_2$  (c)  $\text{Br}_2$  (d) Can't be predicted

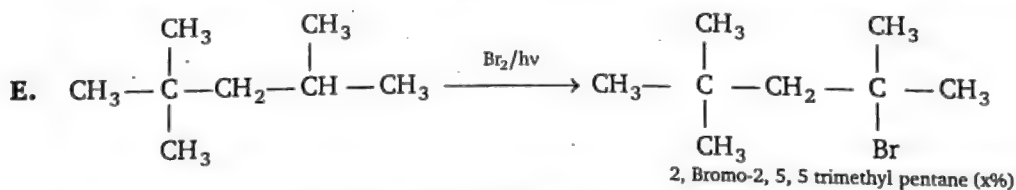


Major product in the above reaction is :

- (a)  $\text{CH}_3 - \overset{\text{CH}_3}{\underset{|}{\text{CH}}} - \text{CH}_2 - \text{Cl}$  (b)  $\text{CH}_3 - \overset{\text{CH}_3}{\underset{\text{Cl}}{|}{\text{CH}}} - \text{CH}_3$   
 (c)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{Cl}$  (d)  $\text{CH}_3 - \overset{\text{Cl}}{\underset{|}{\text{CH}}} - \text{CH}_2 - \text{CH}_3$

- D. Which of the following will give five monochloro products, when allowed to react with  $\text{Cl}_2$  in presence of sun light (excluding stereoisomers) ?

- (a) *n*-pentane (b) Iso-pentane (c) 2-methyl-pentane (d) 3-methyl pentane

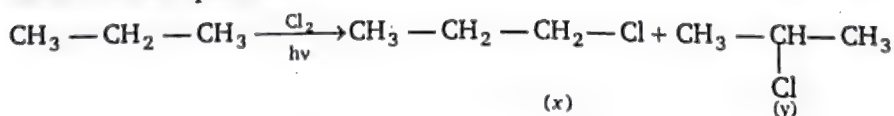


2, Bromo-2, 5, 5 trimethyl pentane (x%)

What is the value of x (% yield of product)?

- (a) 18 % (b) 82 % (c) 90 % (d) 60 %

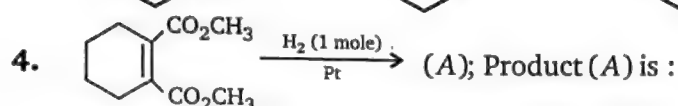
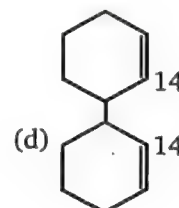
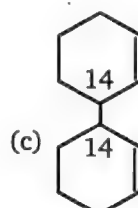
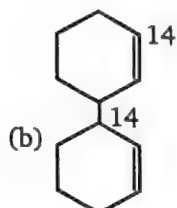
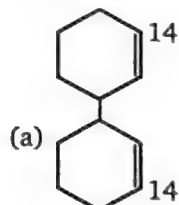
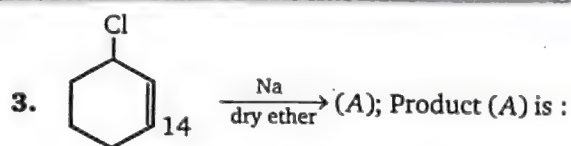
- F. What would be the product ratio x/y in the chlorination of propane if all the hydrogen were abstracted at equal rate ?



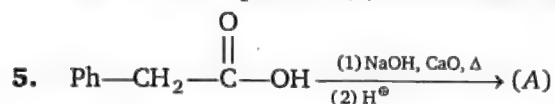
- (a)  $\frac{1}{3}$  (b)  $\frac{3}{1}$  (c)  $\frac{9}{1}$  (d)  $\frac{1}{9}$

- G. How many dichloro products (including stereoisomers) will be formed when R-2-chloropentane reacts with  $\text{Cl}_2$  in presence of UV radiation ?

- (a) 5 (b) 6 (c) 7 (d) 8

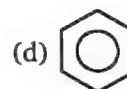


- (a) Meso compound (b) Racemic mixture (c) Diastereomers (d) Optically active




Product (A) is :

- (a)  $\text{Ph}-\text{CO}_2\text{H}$  (b)  $\text{Ph}-\text{CH}_2-\text{OH}$  (c)  $\text{Ph}-\text{CH}_3$



6. Match the column I with column II and with column III.

Column (I)		Column (II)		Column (III)	
Compound		Mono-chloro products (excluding stereoisomerism)		Monochloro products (including stereoisomerism)	
(a)		(p)	1	(w)	1
(b)	$\text{CH}_3-\underset{\text{CH}_3}{\text{CH}}-\text{CH}_2-\text{CH}_3$	(q)	2	(x)	3
(c)	$\begin{array}{c} \text{CH}_3 \text{ CH}_3 \\   \quad   \\ \text{CH}_3-\text{C}-\text{C}-\text{CH}_3 \\   \quad   \\ \text{CH}_3 \text{ CH}_3 \end{array}$	(r)	3	(y)	5
(d)	$\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_3$	(s)	4	(z)	6

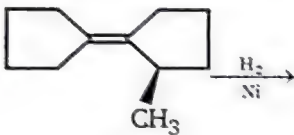
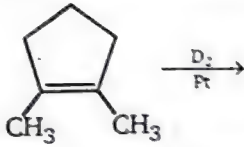
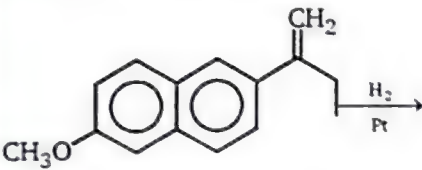
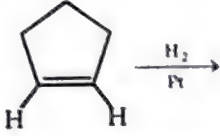


7.

A.	$R\text{-}2\text{-chloropentane} \xrightarrow[h\nu]{Cl_2} \text{Optically active di-chloro products (P)}$
B.	$\square \xrightarrow[h\nu]{Cl_2} \text{Optically active dichloro products (Q)}$
C.	$R\text{-}2\text{-chlorobutane} \xrightarrow[h\nu]{Cl_2} \text{Optically active di-chloroproducts (R)}$

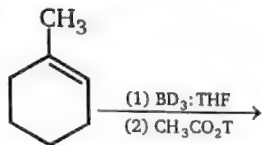
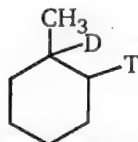
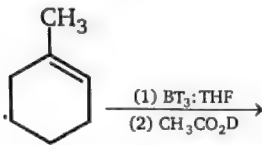
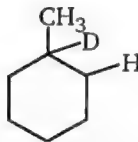
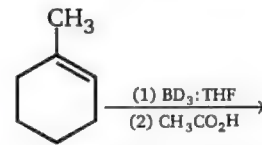
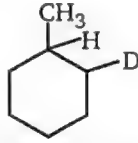
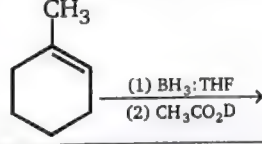
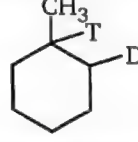
Sum  $P + Q + R$  is :

8. Match the column I and II.

Column (I)		Column (II)	
Reaction		Type of Reaction	
(a)		(p)	Meso compound
(b)		(q)	Diastereomers
(c)		(r)	Racemic
(d)		(s)	Optically inactive due to absence of chiral center



## 9. Match the column :

Column (I)		Column (II)	
Reaction		Product	
(a)		(p)	
(b)		(q)	
(c)		(r)	
(d)		(s)	

10. How many distinct monochlorinated products, (including stereoisomers) may be obtained when the alkane shown below is heated in the presence of  $\text{Cl}_2$  ?



- (a) 1                      (b) 2                      (c) 3                      (d) 4                      (e) 6

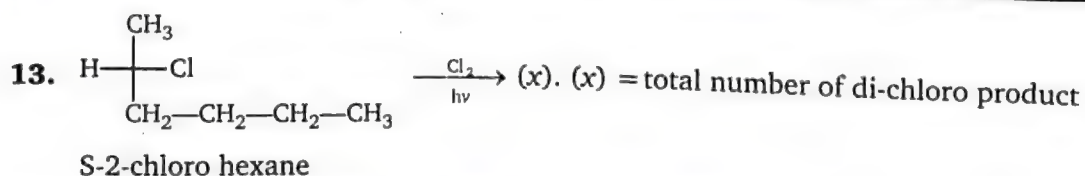
11. How many distinct monochlorinated products, (including stereoisomers) may be obtained when the alkane shown below is heated in the presence of  $\text{Cl}_2$  ?



- (a) 2                      (b) 4                      (c) 5                      (d) 6                      (e) 8

## 12. Match the column :

Column (I)		Column (II)	
	Wurtz reaction		Number of dimerization product
(a)	$\text{CH}_3 - \text{Cl} \xrightarrow[\text{dry ether}]{\text{Na}}$	(p)	5
(b)	$\text{CH}_3 - \text{Cl} + \text{CH}_3 - \text{CH}_2 - \text{Cl} \xrightarrow[\text{dry ether}]{\text{Na}}$	(q)	6
(c)	$\text{CH}_3 - \text{Cl} + \text{CH}_3 - \text{CH}_2 - \text{Cl}$ $+ \text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{Cl} \xrightarrow[\text{dry ether}]{\text{Na}}$	(r)	3
(d)	$\text{H}_2\text{C} = \text{CH} - \text{CH} = \text{CH} - \text{CH}_2 - \text{Cl}$ $+ \text{CH}_3 - \text{CH}_2 - \text{Cl} \xrightarrow[\text{dry ether}]{\text{Na}}$	(s)	1



## HYDROCARBONS (ALKANES)

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## ANSWERS — LEVEL 2

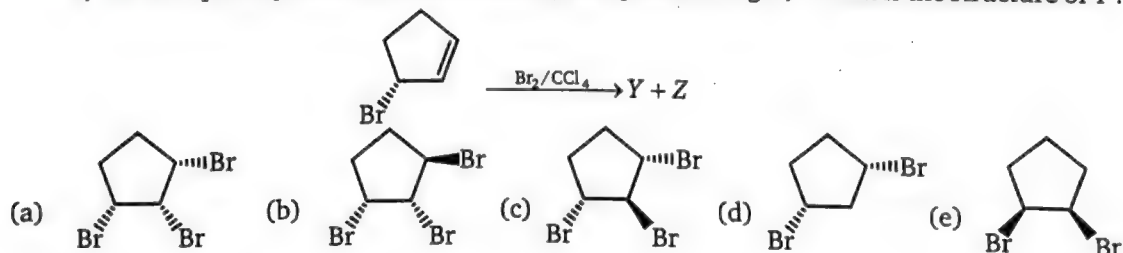
1. A - a; B - c; C - b
2. A - b; B - c; C - a; D - c; E - c; F - b; G - c
3. a, b, c
4. a
5. c
6. a - q - x; b - s - z; c - p - w; d - q - x
7.  $P + Q + R = 10$
8. a - q; b - p; c - r; d - s
9. a - p; b - s; c - q; d - r
10. a
11. e
12. a - s; b - r; c - p; d - q
13. 9

# 4B

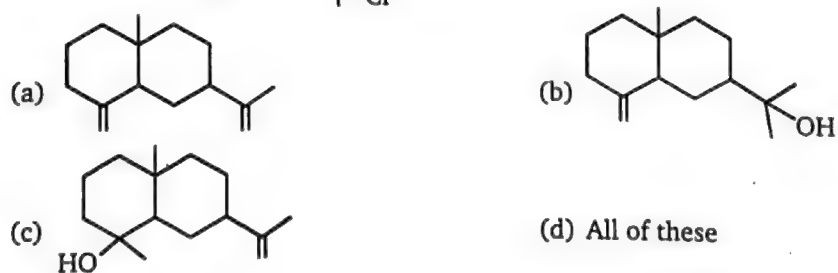
# HYDROCARBONS (ALKENES)

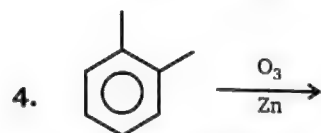
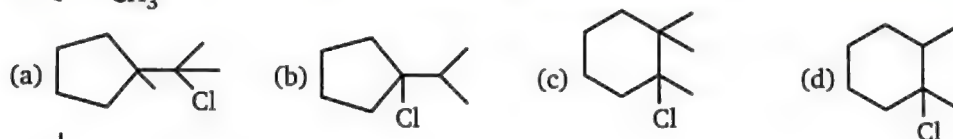
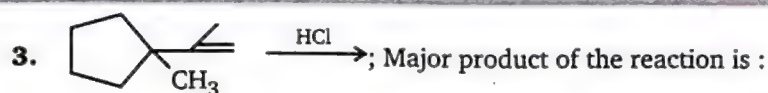
## LEVEL-1

1. (R)-3-bromocyclopentene (shown below) reacts with  $\text{Br}_2/\text{CCl}_4$  to form two products, Y and Z, Y is not optically active (does not rotate plane-polarized light). What is the structure of Y?

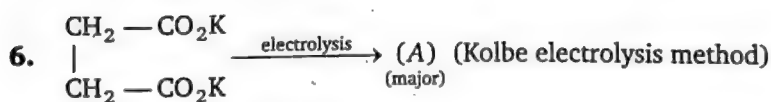
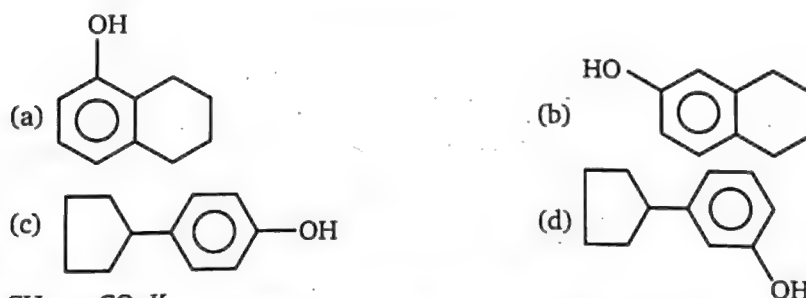
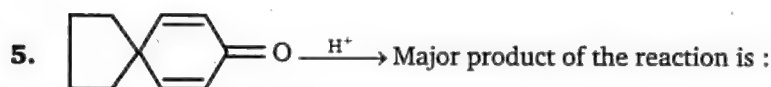
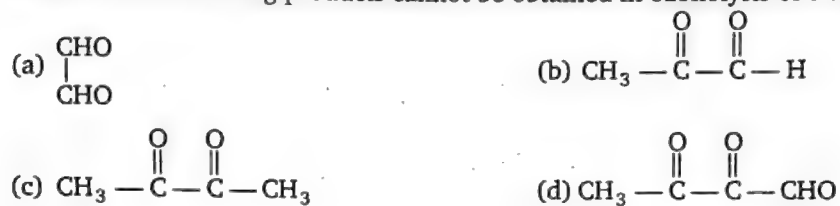


2.  $\text{A} \xrightarrow{2\text{HCl}}$  . Reactant (A) can be:

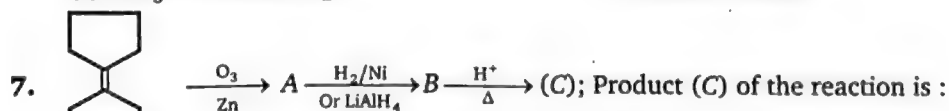


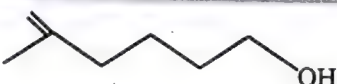


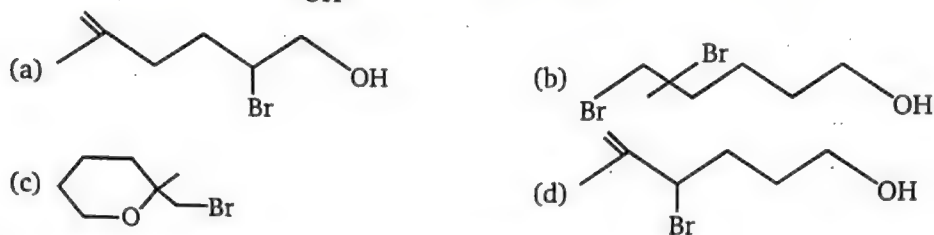
Which of the following products cannot be obtained in ozonolysis of o-xylene?



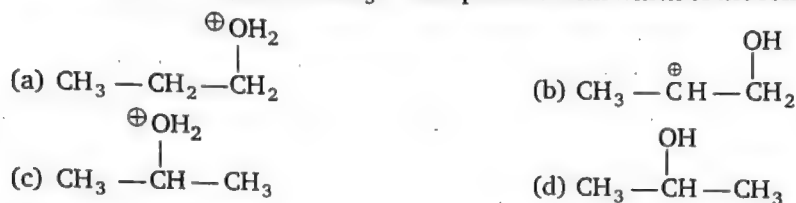
Product (A) of the reaction is :



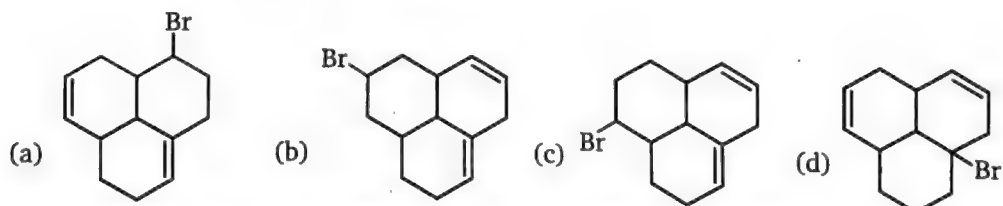
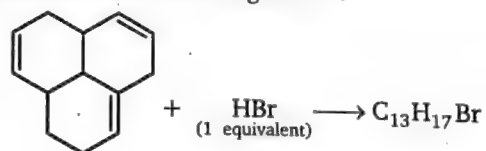
8.   $\xrightarrow[\text{CH}_2\text{Cl}_2]{\text{Br}_2}$  W. Product W is :



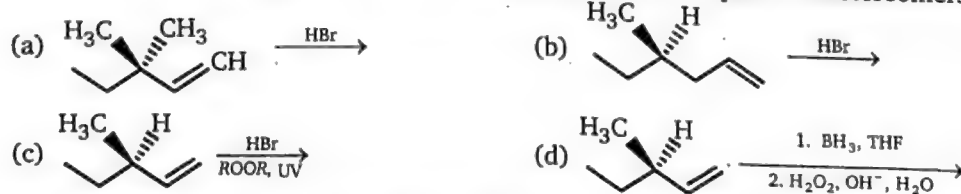
9. The reaction of propene with  $\text{H}_3\text{O}^+$  will proceed with which of the following intermediates ?



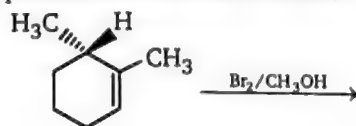
10. Which of the following bromides is the major product of the reaction shown below, assuming that there are no carbocation rearrangement ?

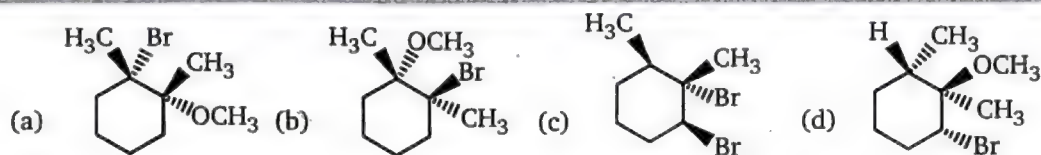


11. Which of the following reactions results in the formation of a pair of diastereomers ?

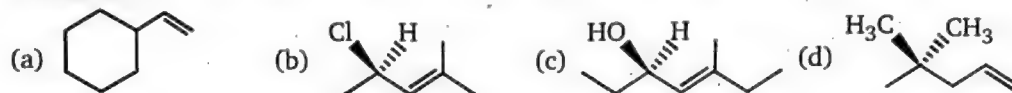


12. What is a likely product of the reaction shown ?

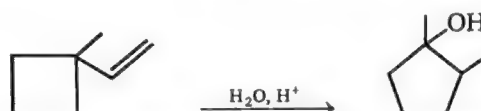




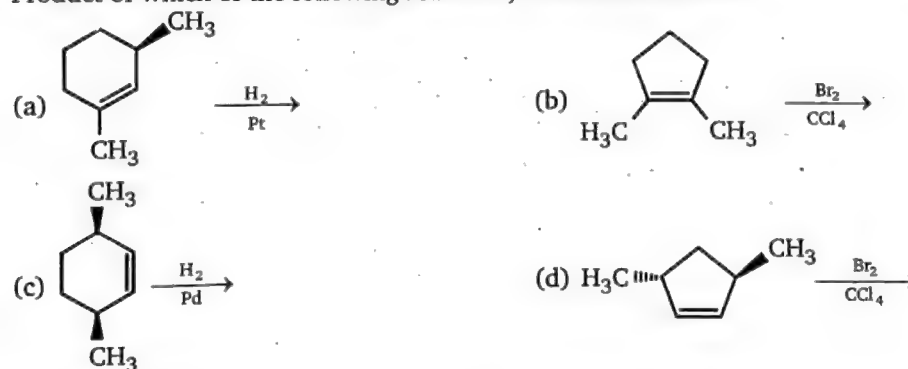
13. Which of the following, when undergoing addition of HBr, will form ONLY a pair of diastereomers?



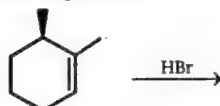
14. How many transition states and intermediates will be formed during the course of following reaction?



- (a) 3 transition states and 3 intermediates (b) 4 transition states and 3 intermediates  
(c) 3 transition states and 2 intermediates (d) 5 transition states and 4 intermediates
15. Product of which of the following reactions, is racemic mixture?



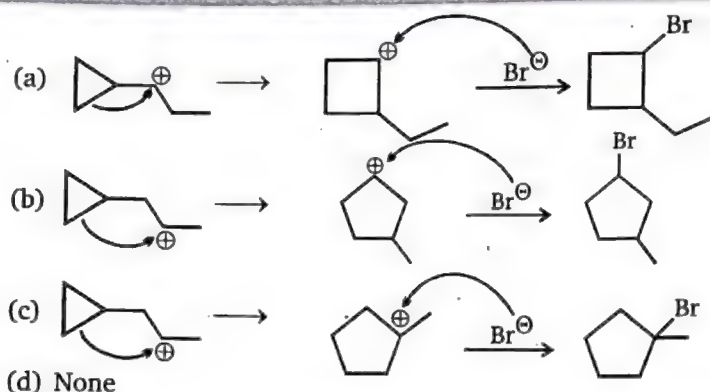
16. The product(s) of the following reaction can best be described as:



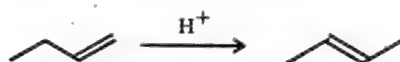
- (a) a racemic mixture (b) a single enantiomer  
(c) a pair of diastereomers (d) an achiral molecule
17. Taking into account the stability of various carbocations and, as well as the rules governing mechanisms of carbocation rearrangements, which reaction is most likely to occur during the given reaction?



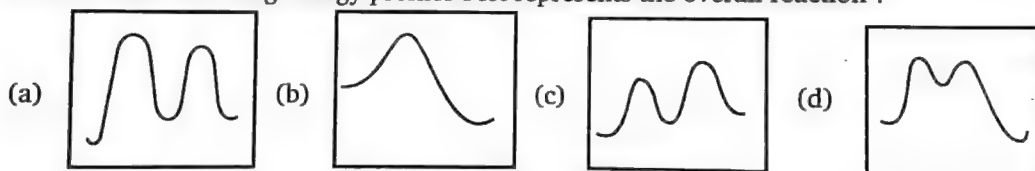




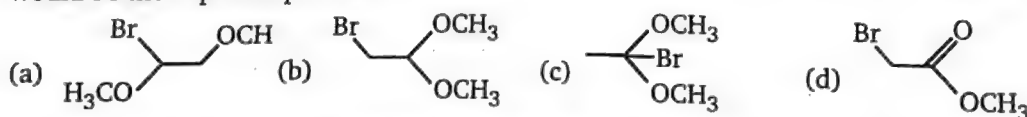
18. Consider the following reaction in which the intermediate carbocation loses  $H^+$  to give the final product ?



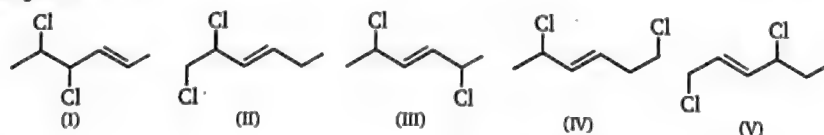
Which of the following energy profiles best represents the overall reaction ?



19. Methyl vinyl ether,  $H_2C=CH-OCH_3$ , reacts with  $Br_2/CH_3OH$ . If methanol is reacting as water would, and if this reaction follows a typical mechanism of electrophilic addition, what would be the expected product ?

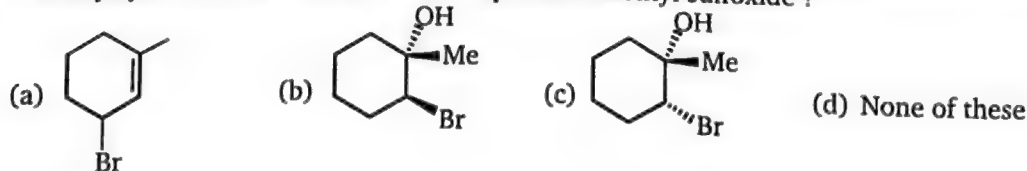


20. 2, 4-hexadiyne ( $C_6H_6$ ) is allowed to react with Li in  $NH_3(liq)$ . The product obtained is treated with 1 equivalent of  $Cl_2$  in  $CCl_4$ . Which of the following constitutional isomers are possible products ?

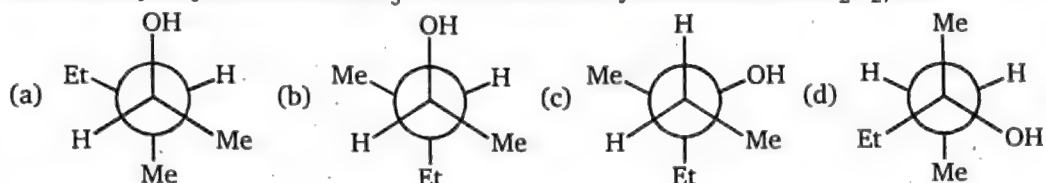


- (a) I and II  
(b) II and III  
(c) I and V  
(d) I and III

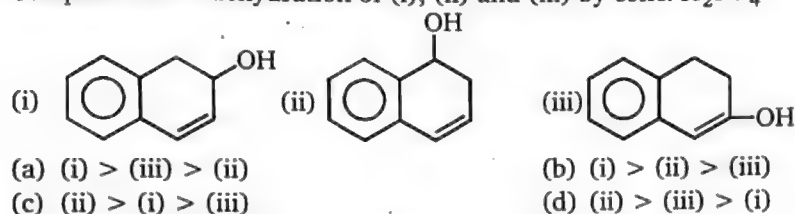
21. Which of the following is the best stereochemical representation when reaction between 1-methylcyclohexene and NBS react in aqueous dimethyl sulfoxide ?



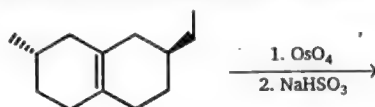
22. Which of the following is among the major products of the reaction of (E)-3-methyl-2-pentene with  $\text{BH}_3$  in THF followed by the addition of  $\text{H}_2\text{O}_2/\text{HO}^-$ ?

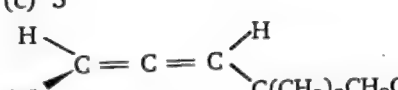


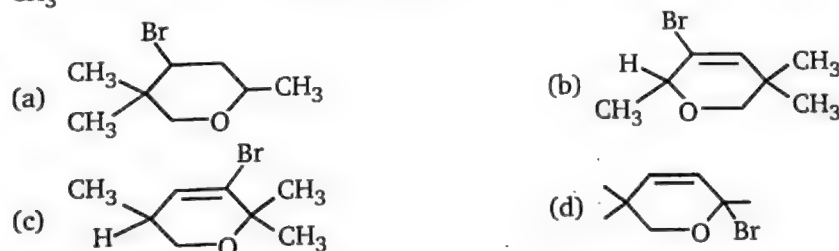
23. Compare rate of dehydration of (i), (ii) and (iii) by conc.  $\text{H}_2\text{SO}_4$ .



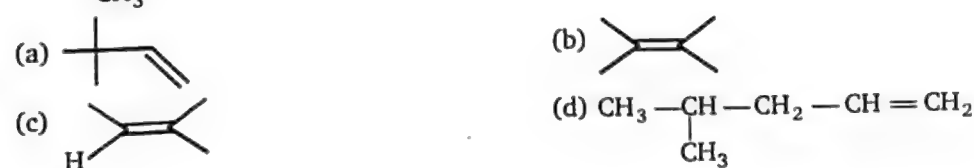
24. How many products will be formed in this reaction?



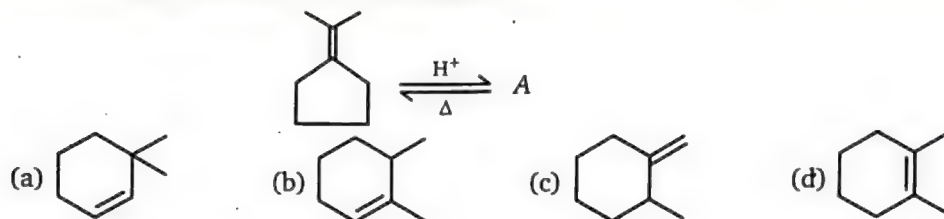
- (a) 10 (b) 2  
(c) 3 (d) 4
25.   $\xrightarrow[\text{CCl}_4]{\text{Br}_2}$  (A). Product (A) of the reaction is:



26.  $\text{CH}_3-\text{CH}(\text{CH}_3)_2 + \text{H}_2\text{C}=\text{CH}_2 \xrightarrow[2-5^\circ\text{C}]{\text{HF}} (\text{A})$ ; (A) is:



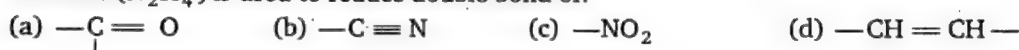
27. Predict the product (A) of the following reaction



28. (A) Major-product (A) is:



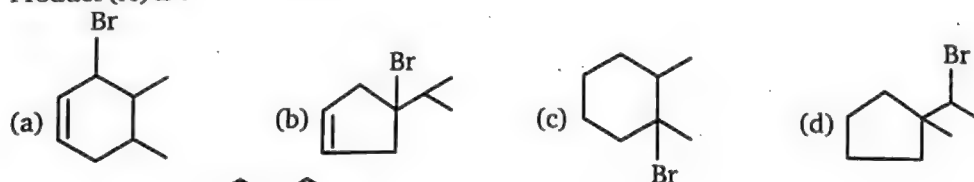
29. Di-imide ( $N_2H_4$ ) is used to reduce double bond of:



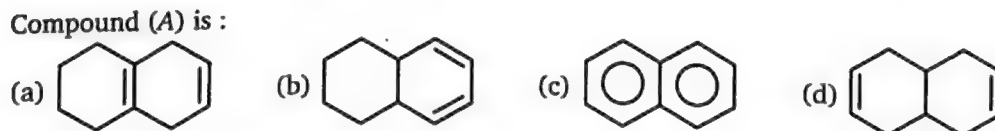
30. End product of the reaction is :

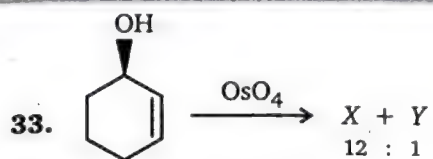


31. Product (A) is :

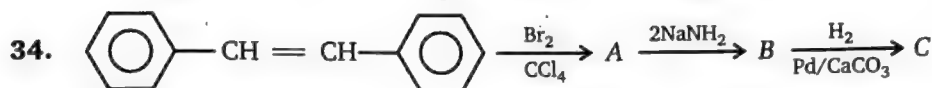
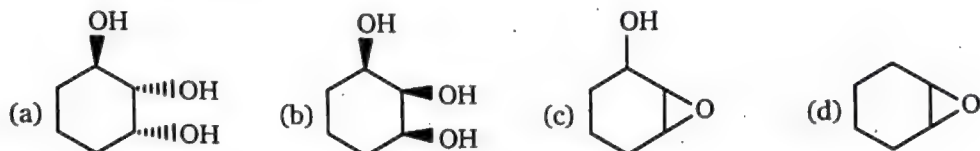


32. Compound (A) is :

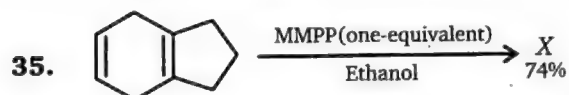
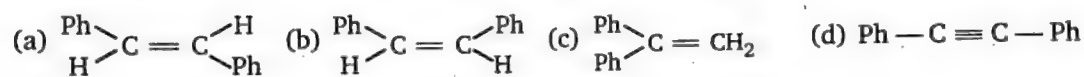




Product (X) will be :

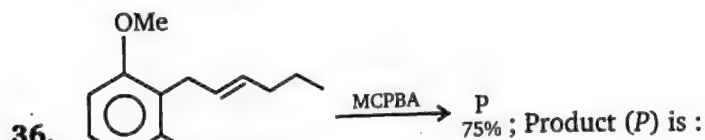
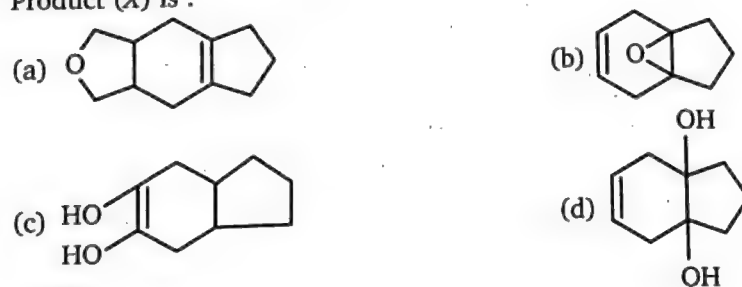


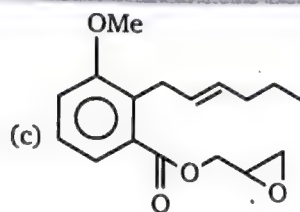
Product (C) is



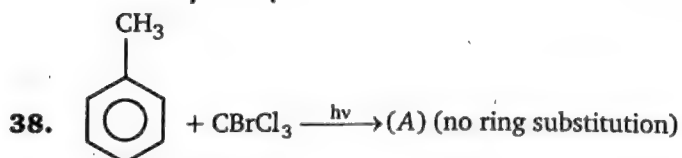
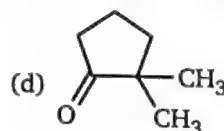
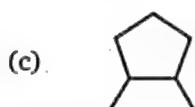
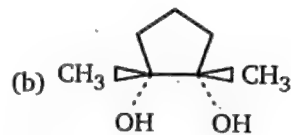
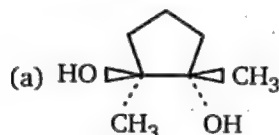
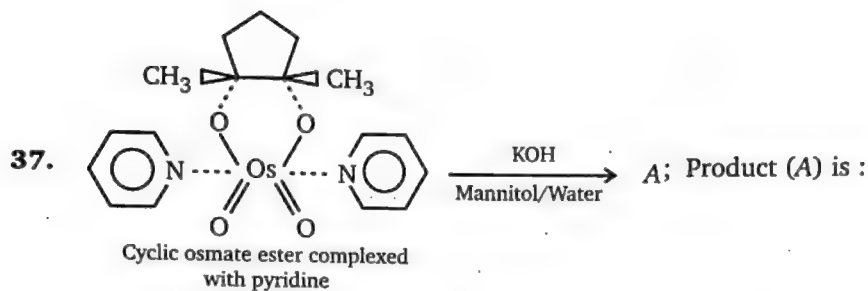
MMPP  $\rightarrow$  Magnesium mono peroxy phthalate.

Product (X) is :

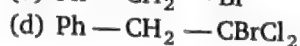
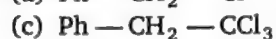
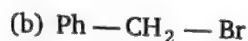
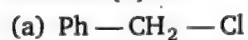




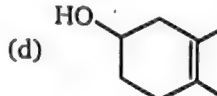
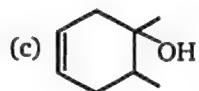
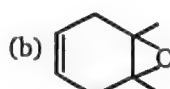
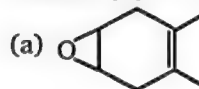
(d) None of these



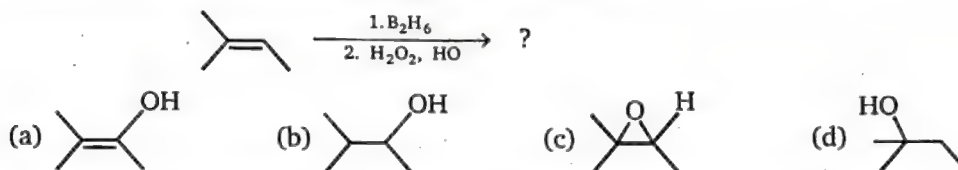
Product (A) is :



Product (A) of the above reaction is :



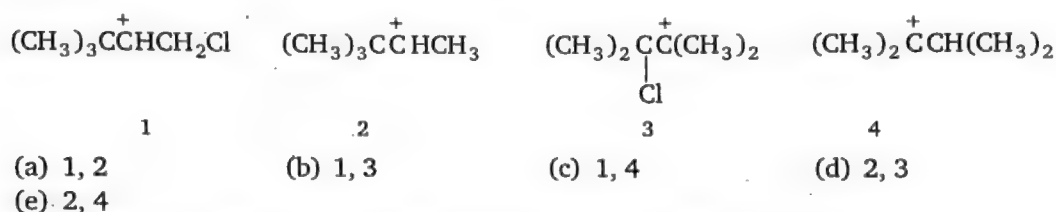
40. The major product of the following reaction sequence is :



41. Which one of the following compounds gives acetone  $(\text{CH}_3)_2\text{C}=\text{O}$  as one of the product of its ozonolysis ?



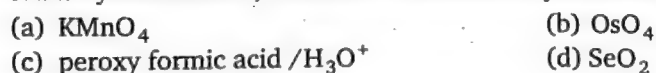
42. Addition of HCl to 3, 3-dimethyl-1-butene yields two products, one of which has a rearranged carbon skeleton. Among the following carbocations, select the possible intermediates in that reaction ?



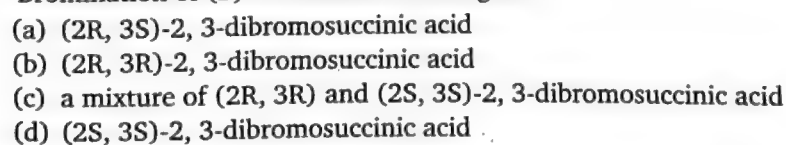
43. Conversion of cyclohexene to cyclohexanol can be conveniently achieved by :



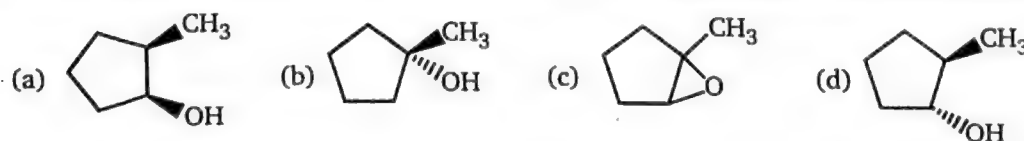
44. *Trans*-cyclohexane-1,2-diol can be obtained by the reaction of cyclohexene with :



45. Bromination of (E)-2-butenedioic acid gives



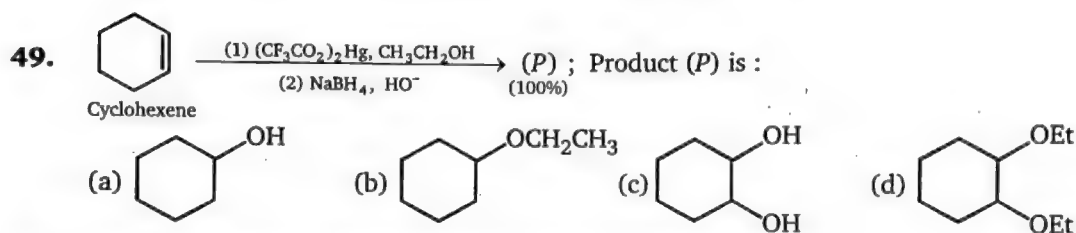
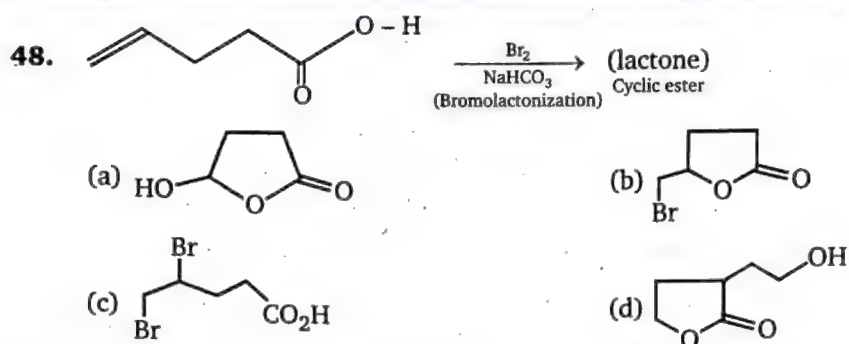
46. The major product formed during the reaction of 1-methyl cyclopentene with  $\text{CH}_3\text{CO}_3\text{H}$  is



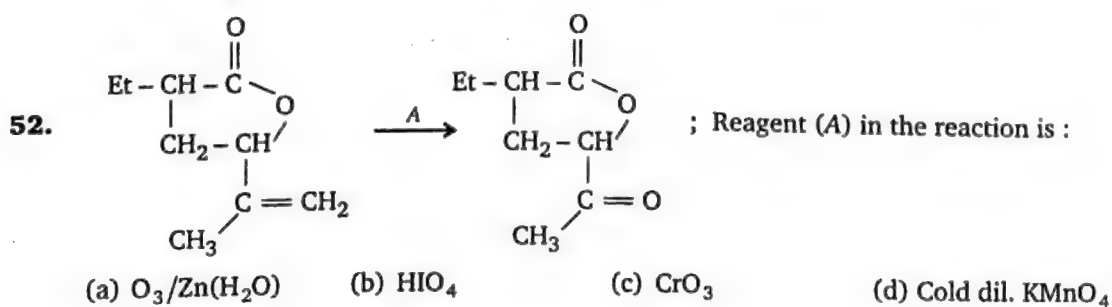
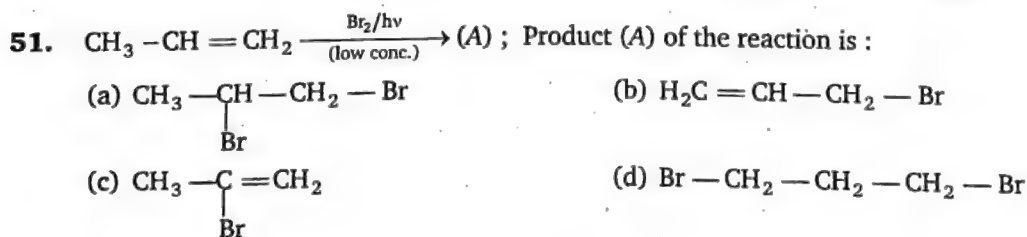
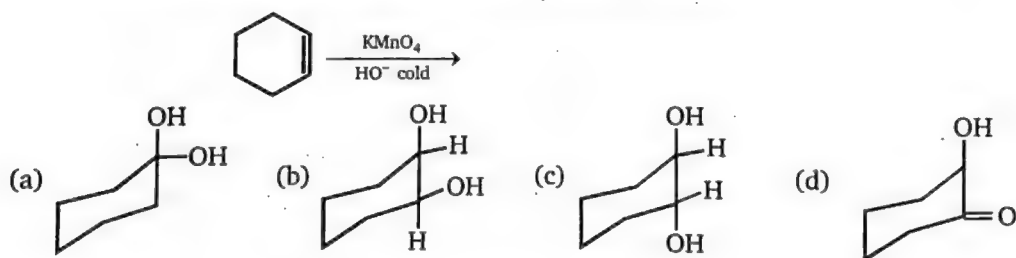
47.  $\begin{array}{c} \text{CH}-\text{CO}_2\text{H} \\ || \\ \text{CH}-\text{CO}_2\text{H} \end{array} \xrightarrow[\text{(two mole)}]{\text{NaOH}} (\text{A}) \xrightarrow{\text{electrolysis}} (\text{B});$  Product (B) of the reaction is :

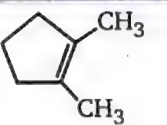
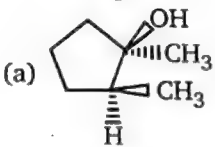
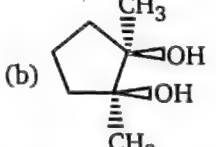
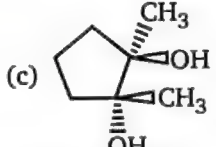
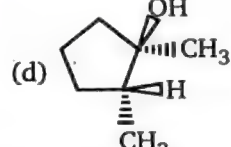
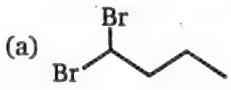
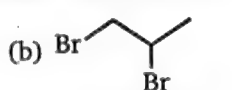

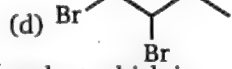
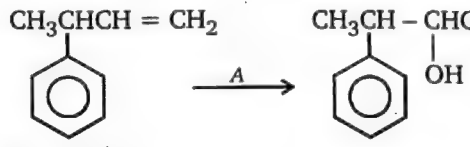
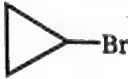
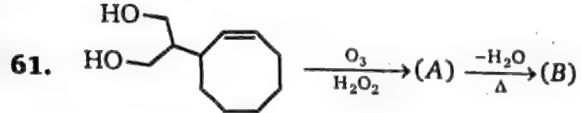


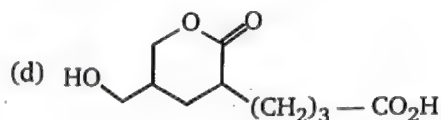
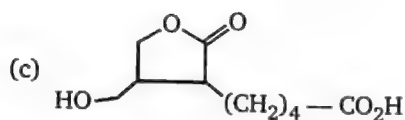
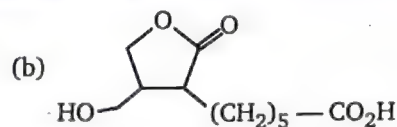
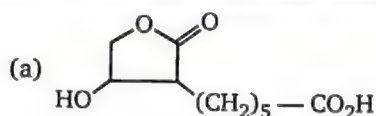




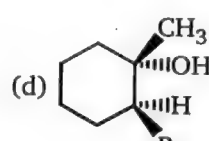
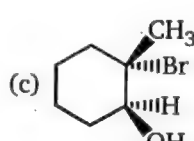
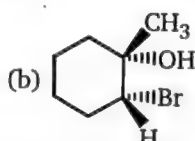
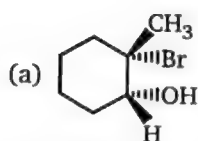
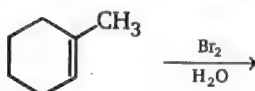
50. What is the major product expected from the following reaction ?



53.   $\xrightarrow[2. \text{NaHSO}_3]{1. \text{OsO}_4}$  Product of the reaction is:
- (a)  (b)  (c)  (d) 
54. Which compound is a possible product from addition of  $\text{Br}_2$  to 1-butene?
- (a)  (b) 
- (c)  (d) 
55. Addition of  $\text{Br}_2$  to *cis*-2-butene would give a product which is:
- (a) achiral (b) racemic (c) meso (d) optically active
56. Addition of  $\text{Br}_2$  to *trans*-2-butene would give a product which is:
- (a) achiral (b) racemic (c) meso (d) optically active
57. Addition of  $\text{OsO}_4$  to cyclopentene would give a product which is:
- (a) achiral (b) racemic (c) meso (d) optically active
58. Addition of  $\text{BH}_3$  followed by  $\text{H}_2\text{O}_2$  to *trans*-2-butene would give a product which is:
- (a) achiral (b) racemic (c) meso (d) optically active
59.  ; Reagent A may be :
- (a)  $\text{H}_2\text{O}/\text{H}^+$  (b)  $\text{BH}_3 \cdot \text{THF}/\text{H}_2\text{O}_2 - \text{OH}^-$   
 (c)  $\text{Hg}(\text{OCOCH}_3)_2, \text{H}_2\text{O}/\text{NaBH}_4, \text{NaOH}$  (d) All are possible
60. The major product of the following reaction is :
- $\text{CH}_3 - \text{CH} = \text{CH}_2 + \text{HBr} \xrightarrow{(\text{C}_6\text{H}_5\text{CO})_2\text{O}_2}$
- (a)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{Br}$  (b)  $\text{CH}_3\text{CH}(\text{Br}) - \text{CH}_3$   
 (c)  $\text{BrCH}_2 - \text{CH} = \text{CH}_2$  (d) 
61.  Identify (B):



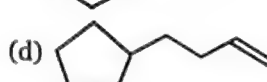
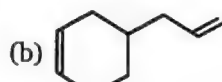
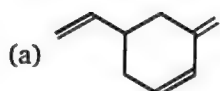
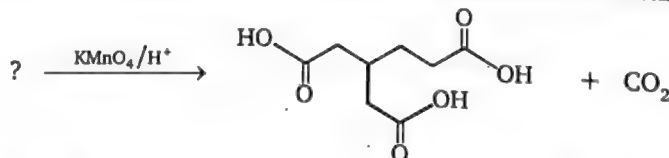
62. Which of the following is a major product of the reaction shown below?



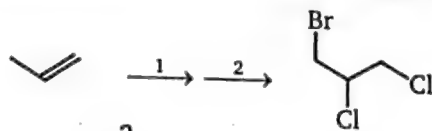
63. In methyl alcohol solution, bromine reacts with ethylene (ethene) to yield  $\text{BrCH}_2\text{CH}_2\text{OCH}_3$  in addition to 1, 2-dibromoethane because

- (a) the methyl alcohol solvates the bromine  
 (b) the ion formed initially may react with  $\text{Br}^-$  or  $\text{CH}_3\text{OH}$   
 (c) this is a free radical reaction  
 (d) the reaction follows Markovnikov's rule

64. Which of the following compound was the starting material for the oxidation shown below?



65. Which series of reactions will achieve the following transformation?



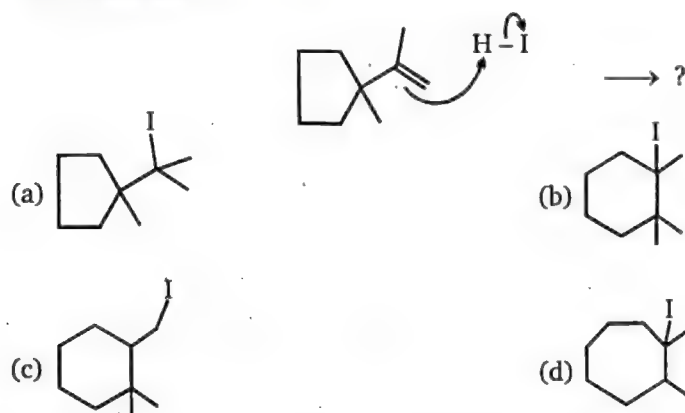
- 1  
 (a)  $\text{Cl}_2/\text{CCl}_4$   
 (c)  $\text{Cl}_2/\text{CCl}_4$

- 2  
 (b)  $\text{Br}_2$   
 (d)  $\text{NBS}/h\nu$

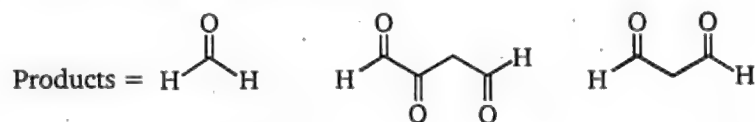
- 1  
 (b)  $\text{HBr}$   
 (d)  $\text{NBS}/h\nu$

- 2  
 (a)  $\text{Cl}_2/\text{CCl}_4$   
 (c)  $\text{Cl}_2/\text{CCl}_4$

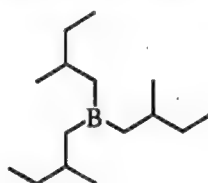
66. Taking into account the stability of various cycloalkanes and carbocations, as well as the rules governing mechanisms of carbocation rearrangements, what is the most likely product of this reaction?



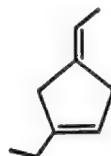
67. A triene is treated with ozone followed by zinc in acetic acid to give the following three products. What is the structure of the triene?



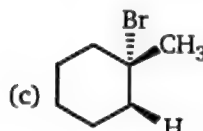
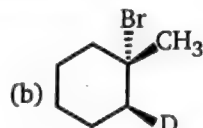
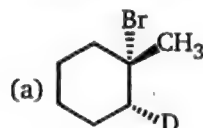
68. Which of the following compound would yield trialkylborane shown below when treated with  $\text{BH}_3/\text{THF}$ ?



- Options:
- (a) 2-methylbut-1-ene
  - (b) 2-methylbut-2-ene
  - (c) 3-methylbut-1-ene
  - (d) 3-methylbut-1-yne
69. If the following compound is treated with  $\text{Pd/C}$  in excess of hydrogen gas, how many stereoisomers of the product will be obtained?

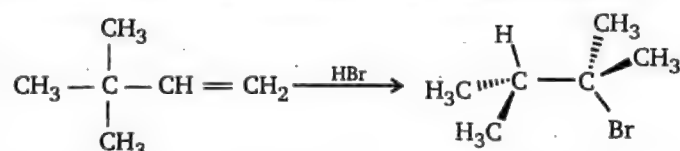


- (a) 1  
(c) 3
- (b) 2  
(d) 4
70. Which is the most precise designation of stereochemistry for the products formed in the electrophilic addition of DBr to 1-methylcyclohexene ? ( $D = {}^2H$ , an isotope of hydrogen)



(d) both (a) and (b)

71. Consider the addition of HBr to 3,3-Dimethyl-1-butene shown below. What is the best mechanistic explanation for the formation of the observed product ?



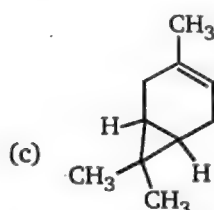
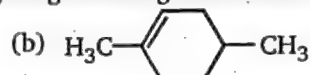
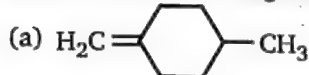
- (a) Protonation of the alkene followed by a hydride shift and addition of bromide to the carbocation  
(b) Double bond shift in the alkene following by the protonation and addition of bromide to the carbocation  
(c) Addition of bromide to the alkene followed by a double bond shift and protonation  
(d) Protonation of the alkene followed by a methyl shift and addition of bromide to the carbocation
72. Propene  $\text{CH}_3\text{CH} = \text{CH}_2$  can be converted into 1-propanol by oxidation. Indicate which sets of reagents amongst the following is ideal to effect the above conversion ?  
(a)  $\text{KMnO}_4$  (alkaline)  
(b) Osmium tetroxide ( $\text{OsO}_4/\text{CH}_2\text{Cl}_2$ )  
(c)  $\text{B}_2\text{H}_6$  and alk.  $\text{H}_2\text{O}_2$   
(d)  $\text{O}_3/\text{Zn}$
73. Which is the most suitable reagent among the following distinguish compound (3) from the others ?  
(1)  $\text{CH}_3\text{C} \equiv \text{C} - \text{CH}_3$   
(2)  $\text{CH}_3\text{CH}_2 - \text{CH}_2 - \text{CH}_3$   
(3)  $\text{CH}_3\text{CH}_2\text{C} \equiv \text{CH}$   
(4)  $\text{CH}_3\text{CH} = \text{CH}_2$   
(a) Bromine in carbon tetrachloride  
(b) Bromine in acetic acid solution  
(c) Alk.  $\text{KMnO}_4$   
(d) Ammonical silver nitrate
74. The principal organic product formed in the reaction given below is :  
 $\text{CH}_2 = \text{CH}(\text{CH}_2)_8\text{COOH} + \text{HBr} \xrightarrow{\text{peroxide}} \dots$   
(a)  $\text{CH}_3 - \text{CHBr}(\text{CH}_2)_8\text{COOH}$   
(b)  $\text{CH}_2 = \text{CH}(\text{CH}_2)_8\text{COBr}$   
(c)  $\text{CH}_2\text{BrCH}_2(\text{CH}_2)_8\text{COOH}$   
(d)  $\text{CH}_2 = \text{CH}(\text{CH}_2)_7\text{CHBrCOOH}$

75. When 2-butyne is treated with Pd – BaSO<sub>4</sub>; the product formed will be :  
 (a) *cis*-2-butene (b) *trans*-2-butene (c) 1-butene (d) 2-hydroxy butane

76. In the reaction,  $\text{CH}_3\text{C}\equiv\text{C}-\text{CH}_3 \xrightarrow[\text{(ii) Zn/H}_2\text{O}]{\text{(i) X}} \text{CH}_3-\text{C}(=\text{O})-\text{C}(=\text{O})-\text{CH}_3$ , X is :

- (a) HNO<sub>3</sub> (b) O<sub>2</sub> (c) O<sub>3</sub> (d) KMnO<sub>4</sub>

77. Which of the following alkene on catalytic hydrogenation given *cis* and *trans*-isomer ?

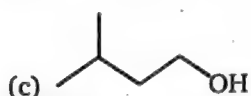
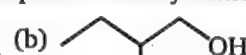


- (d) all of these

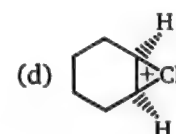
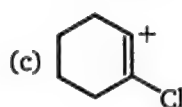
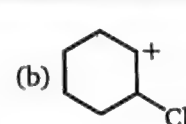
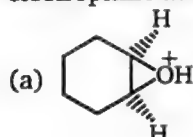
78. In the reaction of hydrogen bromide with an alkene (in the absence of peroxides), the first step of the reaction is the ..... to the alkene.

- (a) fast addition of an electrophilic (b) slow addition of an electrophile  
 (c) fast addition of a nucleophilic (d) slow addition of a nucleophile

79. Which of the following alcohols cannot be prepared from hydration of an alkene ?



80. Which of the species shown below is the most stable form of the intermediate in the electrophilic addition of Cl<sub>2</sub> in water to cyclohexene to form a halohydrin ?



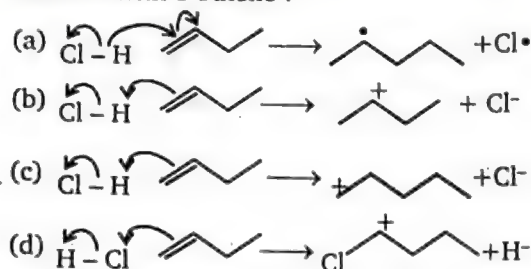
81. The reaction,  $(\text{CH}_3)_2\text{C}=\text{CH}_2 + \text{Br}^\bullet \longrightarrow (\text{CH}_3)_2\dot{\text{C}}-\text{CH}_2\text{Br}$

is an example of a/an ..... step in a radical chain reaction.

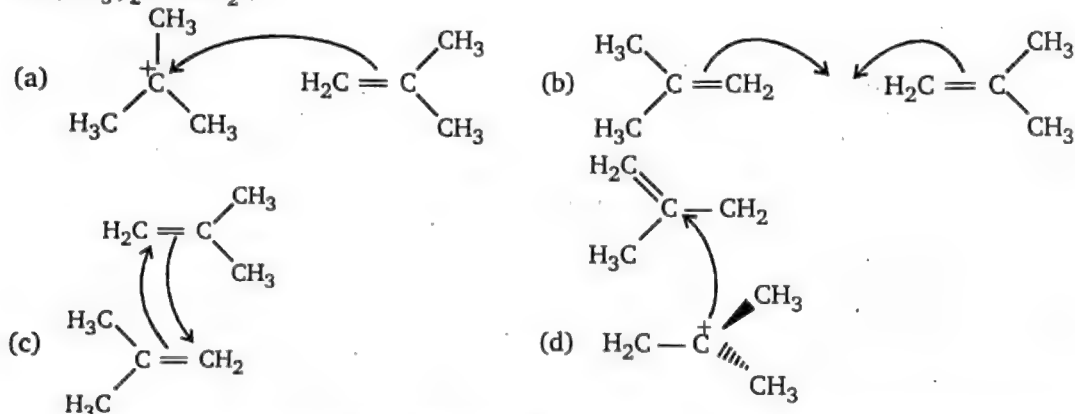
- (a) initiation (b) termination  
 (c) propagation (d) heterolytic cleavage



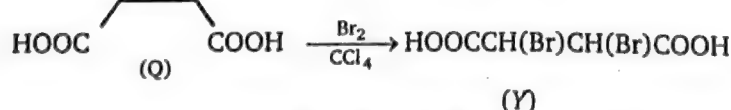
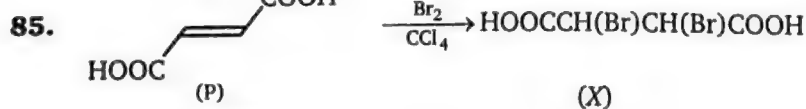
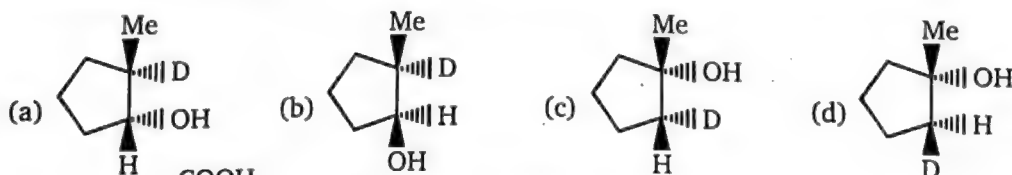
82. Which of the following most accurately describes the first step in the reaction of hydrogen chloride with 1-butene?



83. Which of the following best describes the flow of electrons in the acid-catalyzed dimerization of  $(\text{CH}_3)_2\text{C}=\text{CH}_2$ ?



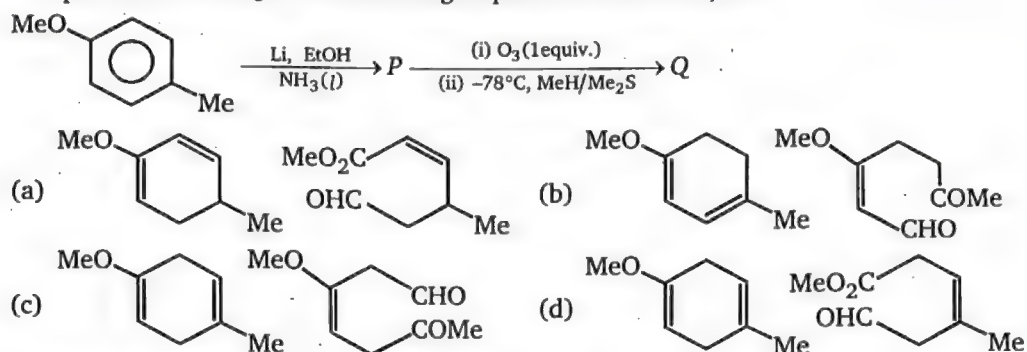
84. Hydroboration of 1-methylcyclopentene using  $\text{B}_2\text{D}_6$ , followed by treatment with alkaline hydrogen peroxide, gives



The correct statements with respect to the above pair of reactions are that

- (I) the reactions are stereospecific  
 (II) (X) is erythro and (Y) is threo isomer  
 (III) (X) is threo and (Y) is erythro isomer  
 (IV) each of (P) and (Q) gives a mixture of (X) and (Y)
- (a) I and II      (b) I and III      (c) I and IV      (d) II and IV

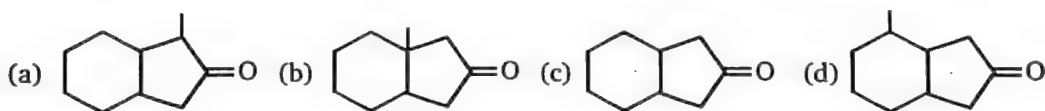
86. The products P and Q in the following sequence of reactions, are



87. 4-Pentenoic acid when treated with  $I_2$  and  $NaHCO_3$  gives :

- (a) 4, 5-diiodopentanoic acid  
 (b) 5-iodomethyl-dihydrofuran-2-one  
 (c) 5-iodo-tetrahydropyran-2-one  
 (d) 4-pentenoliodide

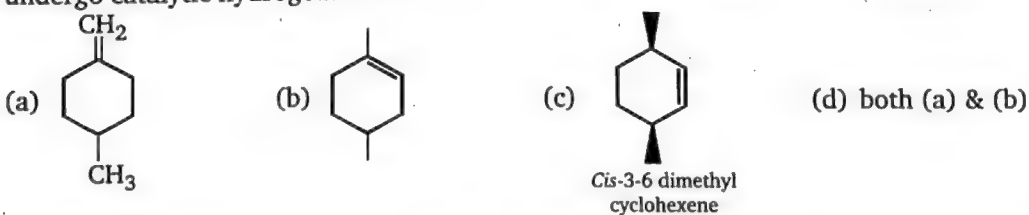
88. Product (B) of the reaction is:



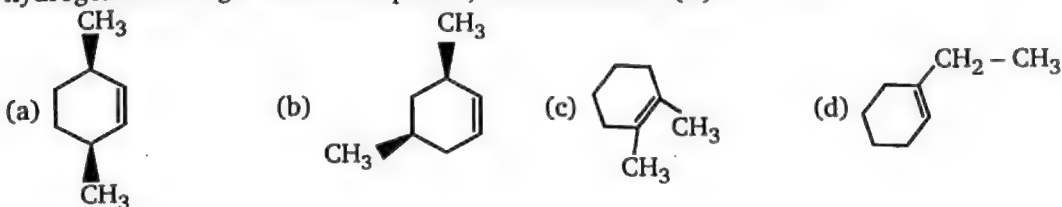
89. Product (C) is :

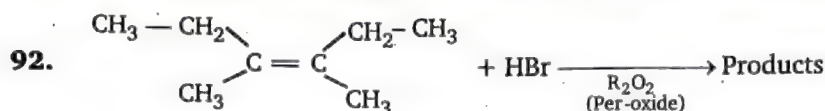
- (a)  $Ph - C \equiv CNa$   
 (b)  $Ph - CH_2 - C \equiv CH$   
 (c)  $Ph - C \equiv C - CH_3$   
 (d)  $Ph - CH = C = CH_2$

90. Which of the following will give a mixture of *cis* and *trans*-1,4-dimethyl cyclohexane, when undergo catalytic hydrogenation ?



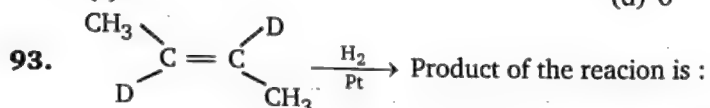
91. An optically active compound A with molecular formula  $C_8H_{14}$  undergoes catalytic hydrogenation to give meso compound, the structure of (A) is :



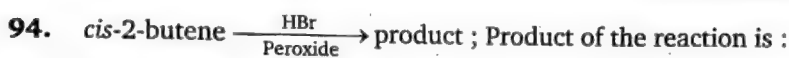


How many products will be formed in above reaction ?

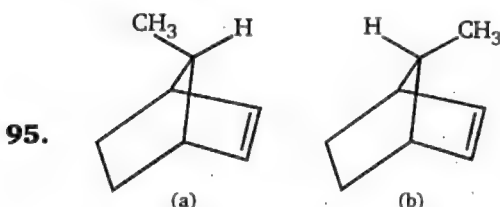
- (a) 2 (b) 4  
(c) 3 (d) 6



- (a) Racemic (b) Diastereomers  
(c) Meso (d) Pure enantiomers

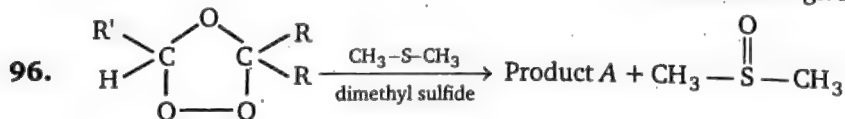


- (a) Racemic (b) Diastereomer  
(c) Meso (d) *E* and *Z* isomer



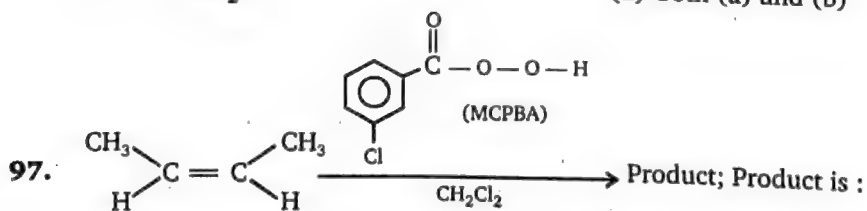
Rate of reaction towards reduction using  $\text{H}_2/\text{Pt}$  :

- (a)  $a > b$  (b)  $a = b$   
(c)  $b > a$  (d) Reduction of given molecule is not possible

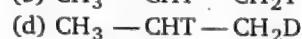
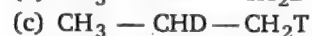
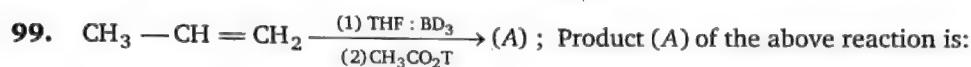
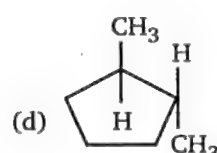
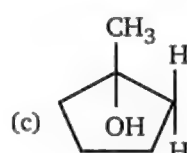
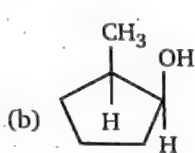
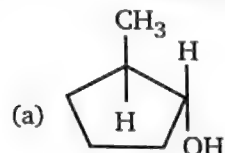
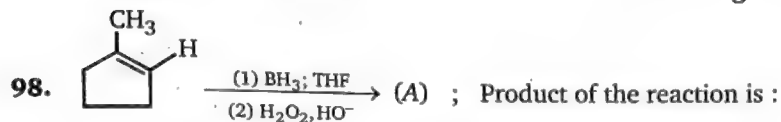
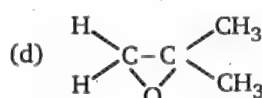
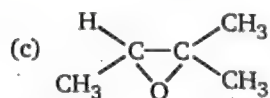
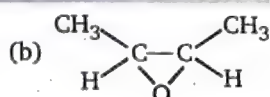
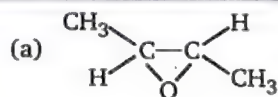


Product A of the above reaction is :

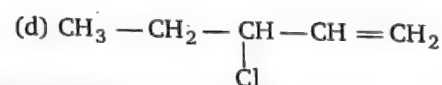
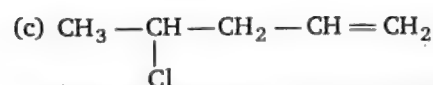
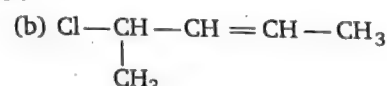
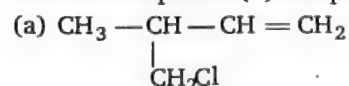
- (a)  $\text{R} - \overset{\text{O}}{\parallel} \text{C} - \text{R}$  (b)  $\text{R}' - \text{CHO}$   
(c)  $\text{R} - \text{CO}_2\text{H}$  (d) both (a) and (b)



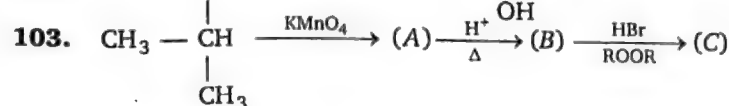
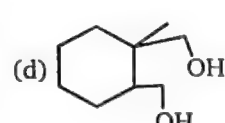
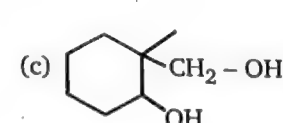
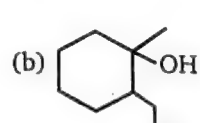
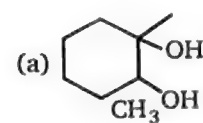
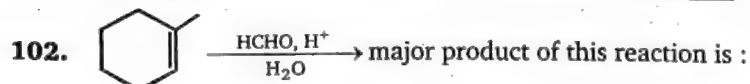
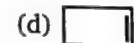
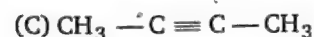
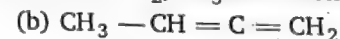
MCPBA  $\longrightarrow$  Metachloroperbenzoic acid



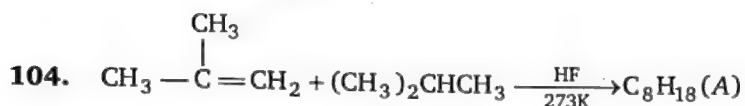
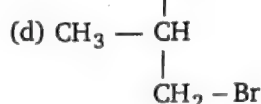
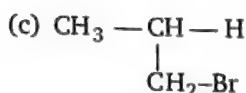
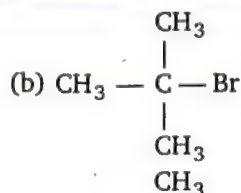
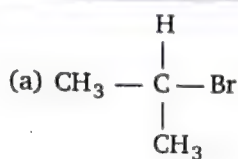
100. Optically active isomer (A) of ( $\text{C}_5\text{H}_9\text{Cl}$ ) on treatment with one mole of  $\text{H}_2$  gives an optically inactive compound (B) compound (A) will be :



101. An organic compound  $\text{C}_4\text{H}_6$  on ozonolysis give  $\text{HCHO}$ ,  $\text{CO}_2$ ,  $\text{CH}_3\text{CHO}$ . Compound will be :



Product (C) in the above reactions is :



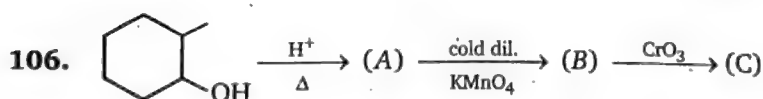
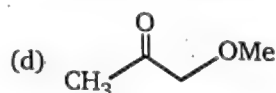
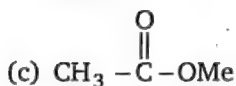
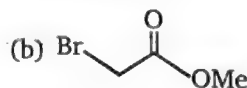
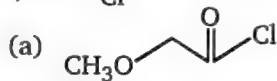
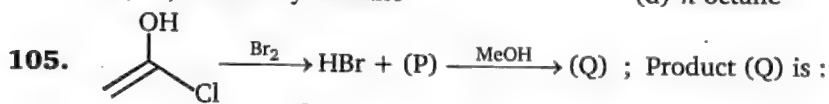
Unknown (A) in the above reaction is :

(a) 2, 2, 3-trimethyl pentane

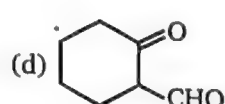
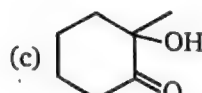
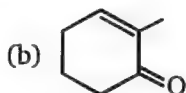
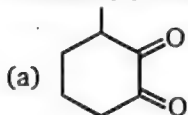
(b) 2, 2, 4-trimethyl pentane

(c) 2, 2-dimethyl hexane

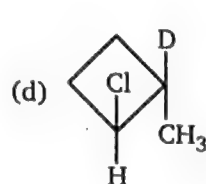
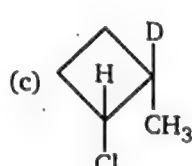
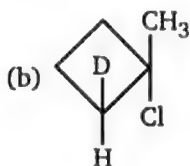
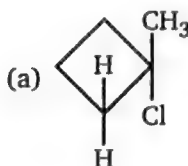
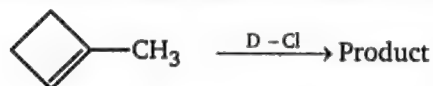
(d) *n*-octane



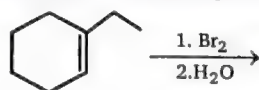
Product (C) of the reaction is:



107. What is the major product expected from the following reaction ?



108. Choose the correct product of this reaction :



- (a) (b) (c) (d)

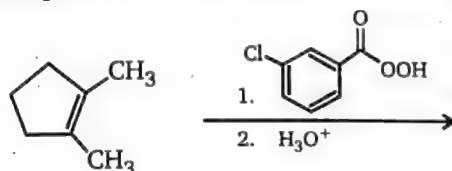
109.  $\xrightarrow[2. \text{H}_2\text{O}_2/\text{OH}^-]{1. \text{BH}_3/\text{THF}}$  A; Product A is:

- (a) (b) (c) (d)

110.  $\xrightarrow[2. \text{NaBH}_4]{1. \text{Hg}(\text{OAc})_2, \text{H}_2\text{O}}$  Product; Product is :

- (a) (b) (c) (d)

111. Choose the correct product of the following reactions :



- (a) (b) (c) (d)

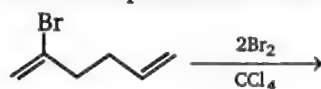
112. How many stereoisomeric tetrabromides will be formed in the following reaction ?



- (a) 2 (b) 3 (c) 4 (d) 6



113. How many stereoisomeric pentabromides will be formed in the following reaction ?



- (a) 2 (b) 3  
(c) 4 (d) None of these

114. (Z) (major)

Identify (Z) in the above sequence of reactions :

- (a) (b)   
(c) (d)

115. 
$$\begin{array}{c} \text{CH}_3 - \text{CH} - \text{CO}_2\text{K} \\ | \\ \text{CH}_3 - \text{CH} - \text{CO}_2\text{K} \end{array} \xrightarrow{\text{electrolysis}} (\text{A}) \text{ (Major)}$$

Major product (A) of the above reaction :

- (a) (b)   
(c) (d)

116. (A) + (B)

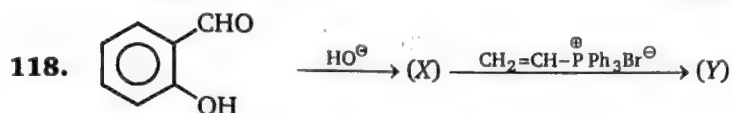
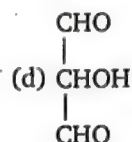
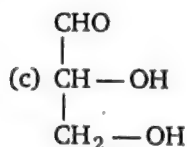
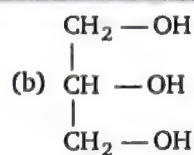
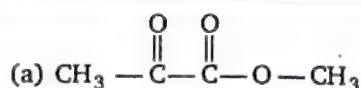
(only one enantiomer is taken)

Which of the following statement is correct about A and B ?

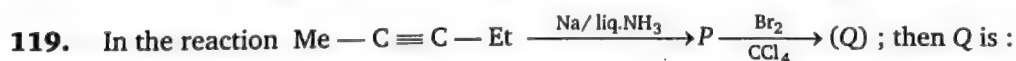
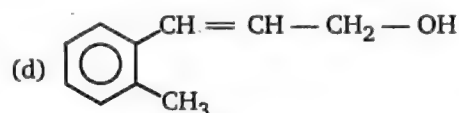
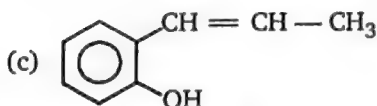
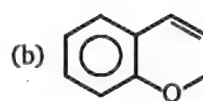
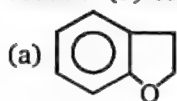
- (a) A and B are mixture of diastereomers  
(b) A and B are mixture of enantiomers  
(c) A and B are optically active  
(d) B is racemic mixture

117. (one of the product)

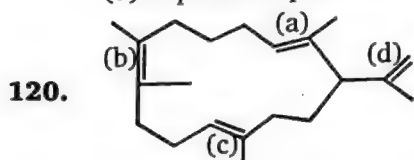
Identify the product (C):



Product (Y) of the above reaction is :



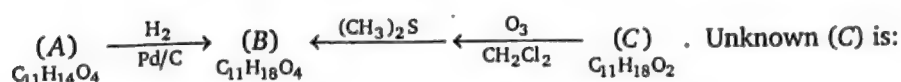
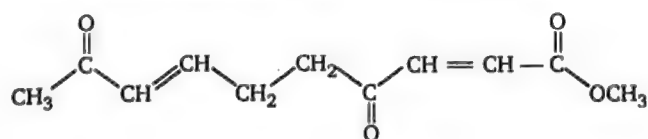
- (a) A pure compound which is optically inactive due to internal compensation  
 (b) A binary mixture which is optically inactive due to external compensation  
 (c) A binary mixture which is optically active  
 (d) A pure compound which is optically inactive due to absence of chiral centre

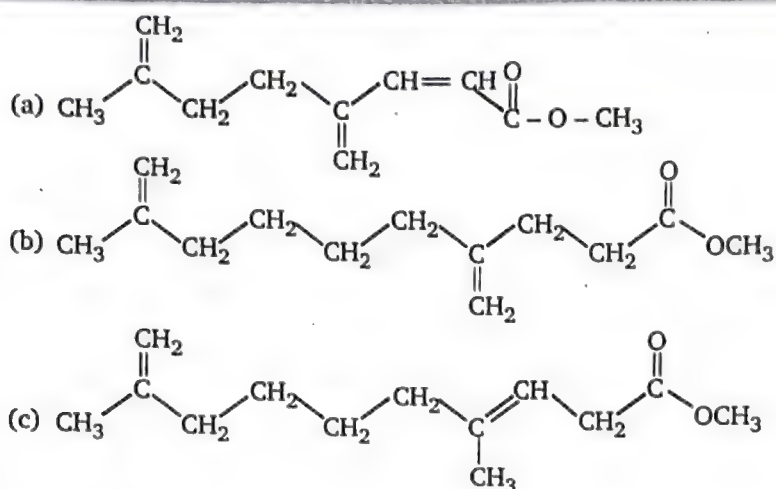


Which ( $\pi$ -bond) will reduce first, when above compound undergoes catalytic hydrogenation ?

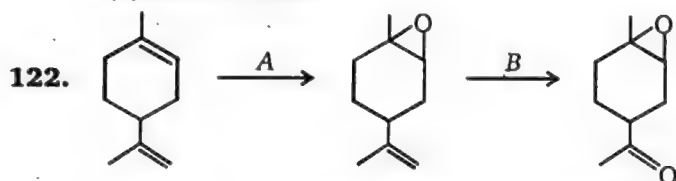
- (a) a (b) b (c) c (d) d

121. Compound A, which is a degradation product of the antibiotic vermiculine has following structure





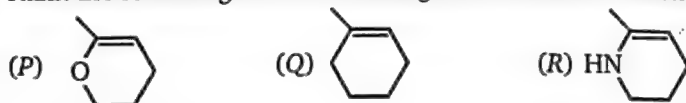
(d) None of these



Reagent (A) and (B) in above reaction are :

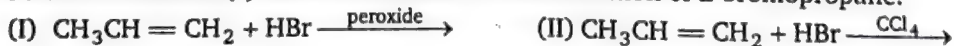
- (a)  $A = \text{RCO}_3\text{H}$ ,  $B = \text{H}_2\text{O}_2$       (b)  $A = \text{RCO}_3\text{H}$ ,  $B = \text{HIO}_4$   
(c)  $A = \text{RCO}_3\text{H}$ ,  $B = \text{O}_3$       (d)  $A = \text{O}_3$ ,  $B = \text{RCO}_3\text{H}$

**123.** Rank the following in the increasing order of rate of reaction with HBr.



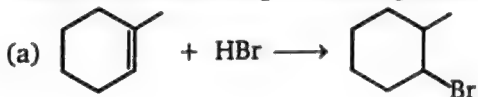
- (a)  $R > P > Q$   
 (c)  $P > R > S$
- (b)  $R > Q > P$   
 (d)  $P > S > R$

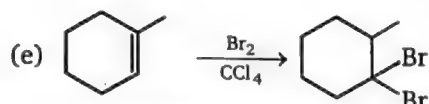
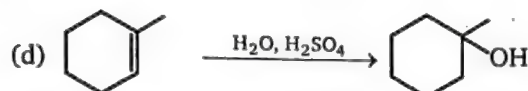
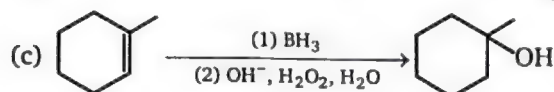
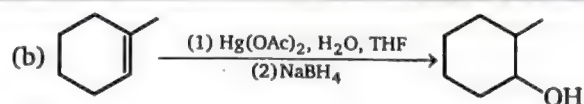
**124.** Select the reaction(s) that would result in the formation of 2-bromopropane.



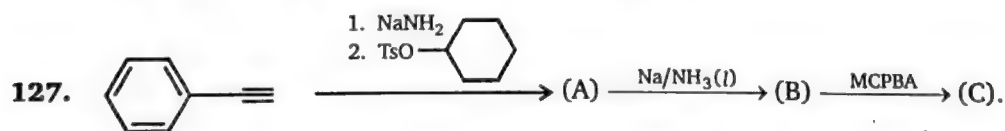
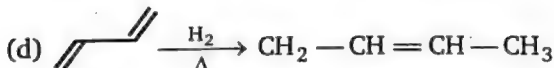
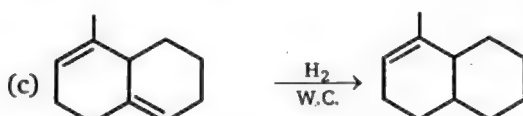
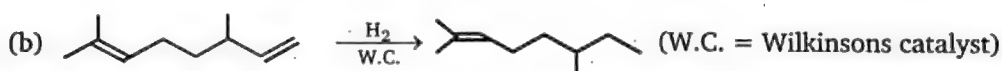
- (a) I and III                      (b) II and III  
(c) I, II, and III                (d) I, II and III

**125.** Which of the following reactions generates the major product? Ignore stereoisomerism.

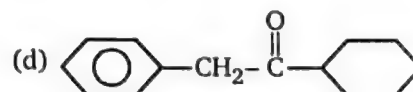
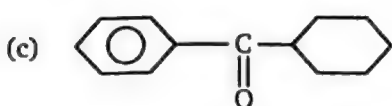
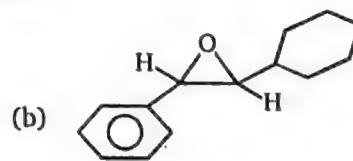
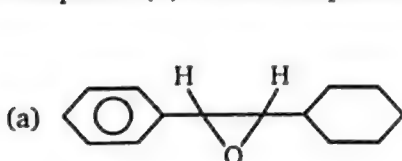


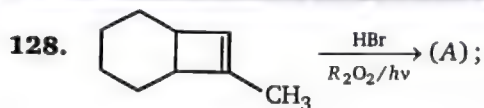


126. In the given selective hydrogenation which combination is incorrect ?

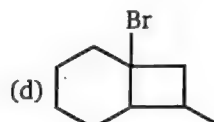
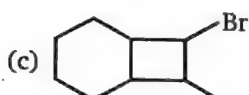
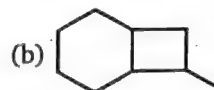
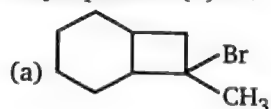


Compound (C) in above sequence of reaction is :

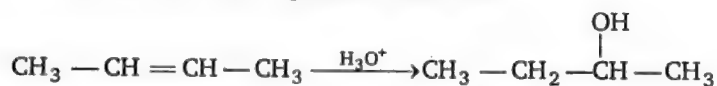




Major product (A) is :



129. In the reaction given below, the product would be :



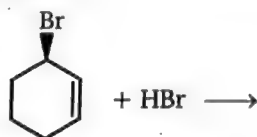
(a) a mixture of diastereomers

(b) optically active

(c) optically pure enantiomer

(d) a racemic mixture

130. Surprisingly, the reaction shown below goes through classical carbocation. What is the major product of this reaction ?



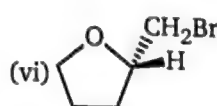
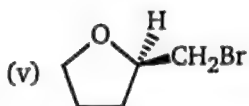
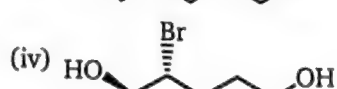
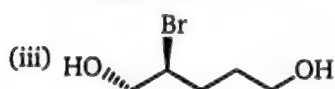
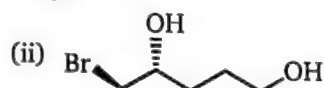
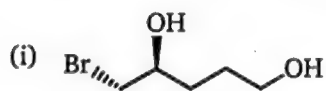
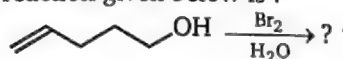
(a) *trans*-1, 3-dibromocyclohexane

(b) *cis*-1, 3-dibromocyclohexane

(c) *trans*-1, 2-dibromocyclohexane

(d) *cis*-1, 2-dibromocyclohexane

131. The major product of the reaction given below is :



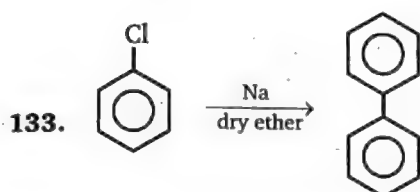
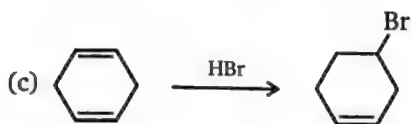
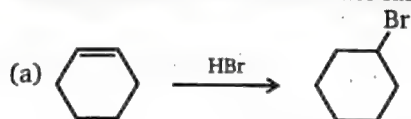
(a) (i) and (ii)

(b) (iii) and (iv)

(c) (v) and (vi)

(d) none of these

132. Which reaction will occur at the fastest rate ?



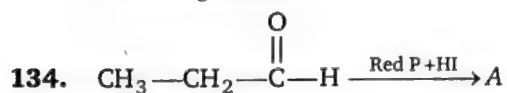
Above reaction is known as :

(a) Wurtz reaction

(b) Wurtz fittig reaction

(c) Fittig reaction

(d) Kolbe electrolysis



Product A is :

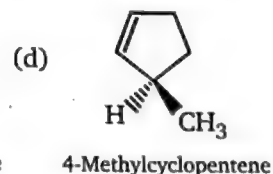
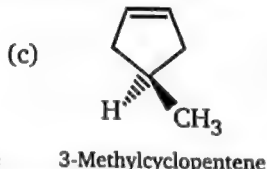
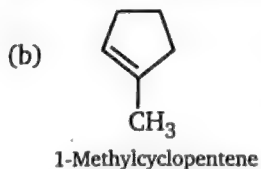
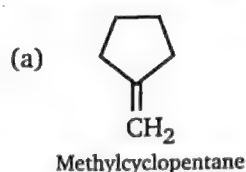
(a) propane

(b) propanol

(c) prapanoic acid

(d) propene

135. Which of the following compound give diastereomers when treated with  $\text{Br}_2$  in  $\text{CCl}_4$ ?



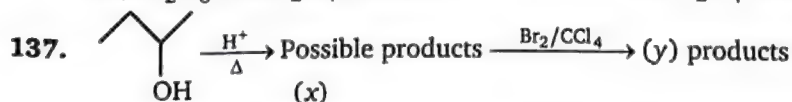
136. A mixture of  $\text{C}_2\text{H}_6$ ,  $\text{C}_2\text{H}_4$  and  $\text{C}_2\text{H}_2$  is bubbled through alkaline solution of copper (I) chloride, contained in Woulf's bottle. The gas coming out is :

(a) original mixture

(b)  $\text{C}_2\text{H}_6$

(c)  $\text{C}_2\text{H}_6$  and  $\text{C}_2\text{H}_4$  mixture

(d)  $\text{C}_2\text{H}_4$  and  $\text{C}_2\text{H}_2$



The number of possible products for x and y is :

(a) 2, 4

(b) 3, 5

(c) 3, 6

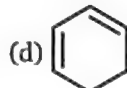
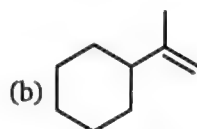
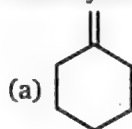
(d) 3, 4



138. Select the incorrect statement :

- (a) Bromine is more selective and less reactive
- (b) Chlorine is less selective and more reactive
- (c) Benzyl free radical is more stable than 2° free radical
- (d) Vinyl free radical more stable than allyl free radical

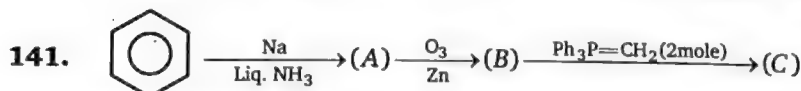
139. Which of the following compound does not evolve CO<sub>2</sub> gas, when undergo oxidative ozonolysis ?



140. *cis*-3-hexene  $\xrightarrow{(a)}$  meso 3,4-hexanediol  
*trans*-3-hexene  $\xrightarrow{(b)}$  meso 3,4-hexanediol.

Choose pair of reagent (a, b) for above conversions.

- (a) Cold KMnO<sub>4</sub>, OsO<sub>4</sub>
- (b) Cold KMnO<sub>4</sub>, RCO<sub>3</sub>H/H<sub>3</sub>O<sup>+</sup>
- (c) RCO<sub>3</sub>H/H<sub>3</sub>O<sup>+</sup>, cold KMnO<sub>4</sub>
- (d) None of these

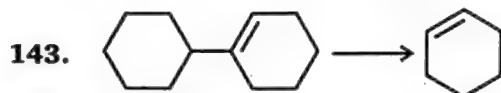


Product (C) of the above reaction is :

- (a) 1,3-hexadiene
- (b) 1,4-pentadiene
- (c) 1,3-butadiene
- (d) 1,3-heptadiene

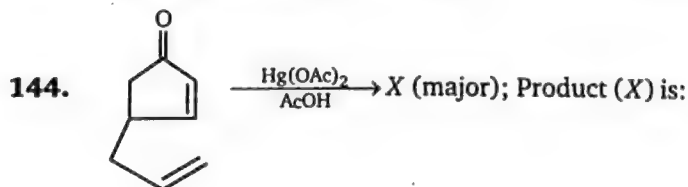
142. How many carbon-hydrogen bond orbitals are available for overlap with the vacant *p*-orbital in ethyl carbocation ?

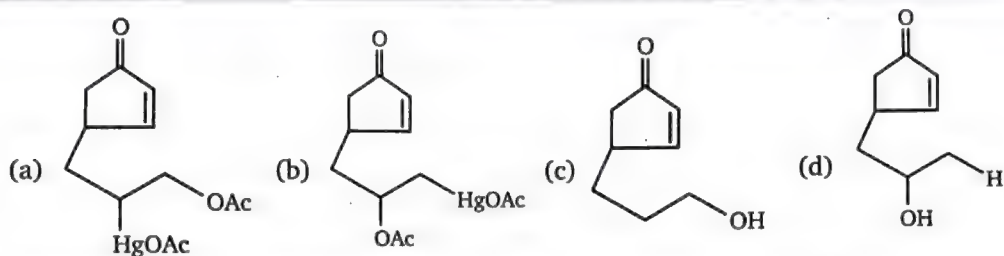
- (a) 0
- (b) 3
- (c) 5
- (d) 6



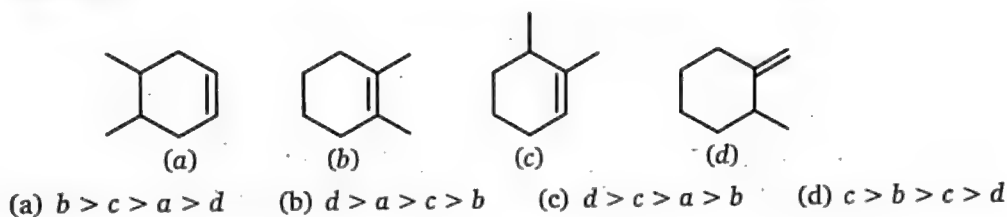
To achieve above conversion, the reagents used will be :

- (a) O<sub>3</sub>/H<sub>2</sub>O<sub>2</sub>, HO<sup>-</sup>/Δ
- (b) HBr, alc. KOH, O<sub>3</sub>, LiAlH<sub>4</sub>, H<sup>+</sup>/Δ
- (c) HBr, *t*-BuOK, O<sub>3</sub>, KMnO<sub>4</sub>, Δ
- (d) HCl, KMnO<sub>4</sub> (cold), H<sup>+</sup>/Δ

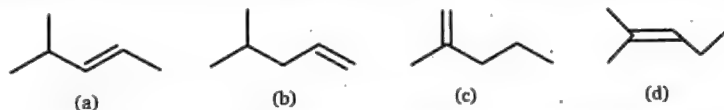




145. Decreasing order of heat evolved upon catalytic hydrogenation of given reactants with a  $H_2$  (Pd/C) is :

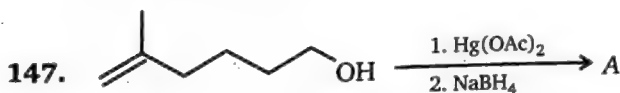


146.

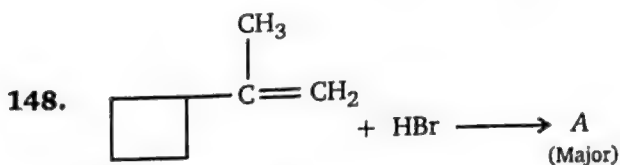
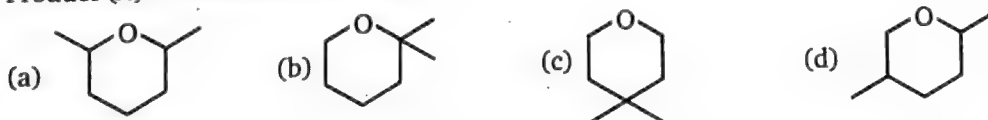


The correct order of heat of hydrogenation of given molecules is :

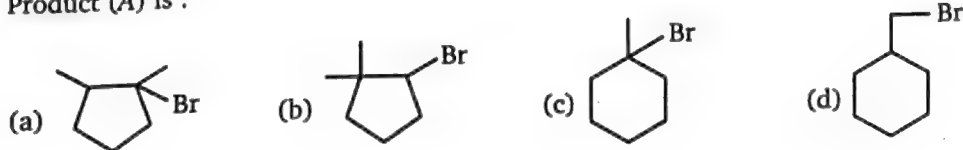
- (a)  $d > c > a > b$  (b)  $d > c > b > a$   
(c)  $b > a > c > d$  (d)  $d > a > c > b$

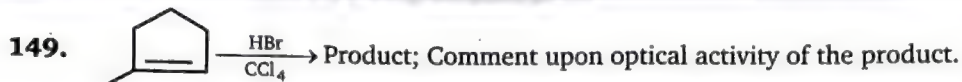


Product (A) of the above reaction is :

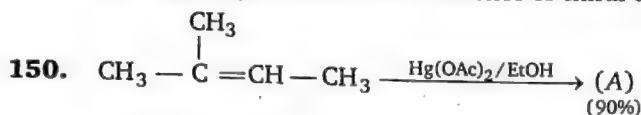


Product (A) is :

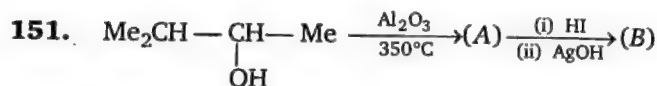
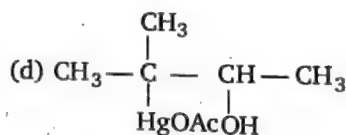
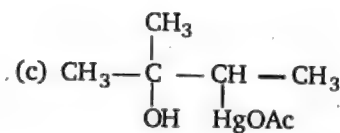
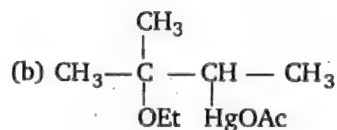
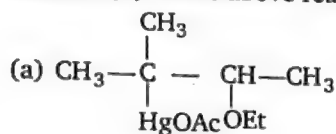




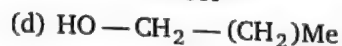
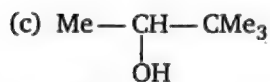
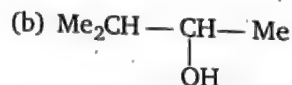
- (a) Racemic mixture  
 (b) Diastereomers  
 (c) Meso  
 (d) Optically inactive due to absence of chiral center



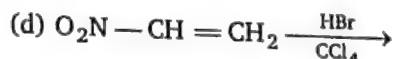
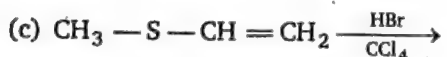
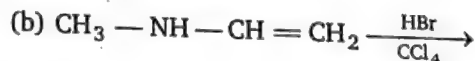
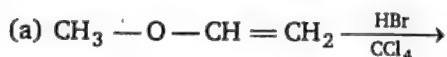
Product (A) of the above reaction is :



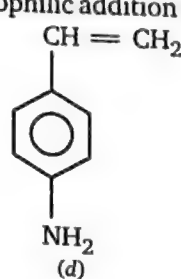
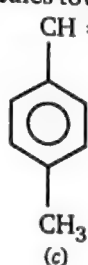
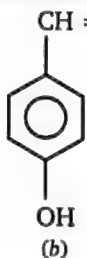
Product (B) of above reaction :

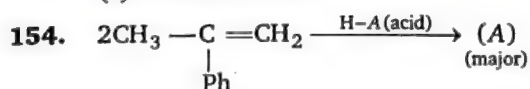


152. In which of the following reaction, Markownikoff's rule is violated ?

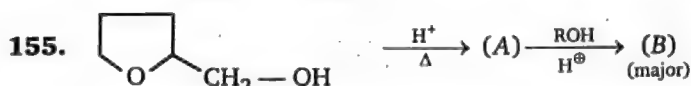
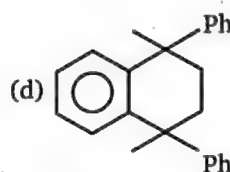
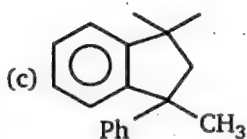
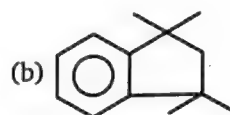
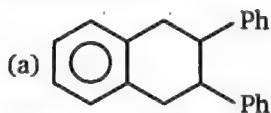


153. Decreasing order of rate of reaction of molecules towards electrophilic addition reaction is :

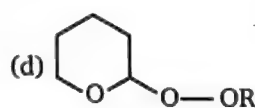
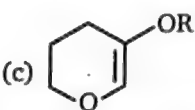
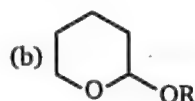
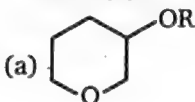


(a)  $a > b > c > d$ (c)  $d > b > c > a$ (b)  $b > c > a > d$ (d)  $b > d > c > a$ 

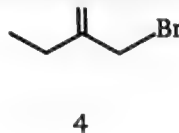
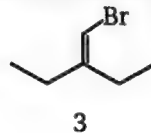
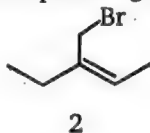
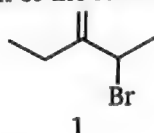
Product (A) is :



Product (B) of the above reaction is :



156. Which of the following compounds gives the same carbocation on ionization ?



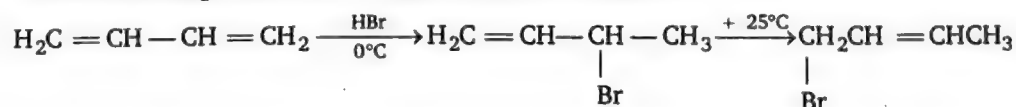
(a) 1 and 3

(b) 2 and 4

(c) 1 and 2

(d) 1 and 4

157. For the following reactions the major products are shown :



These provide an example of 1 control at low temperature and 2 control at higher temperature.

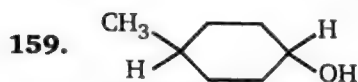
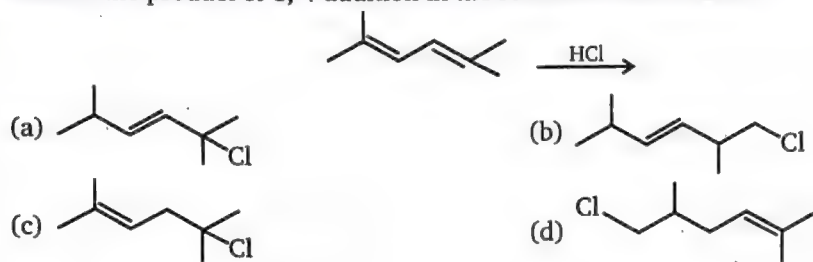
1  
(a) kinetic  
(c) kinetic

2  
thermodynamic  
kinetic

1  
(b) thermodynamic  
(d) thermodynamic

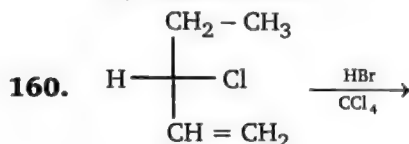
2  
kinetic  
thermodynamic

158. What is the product of 1, 4-addition in the reaction shown below ?



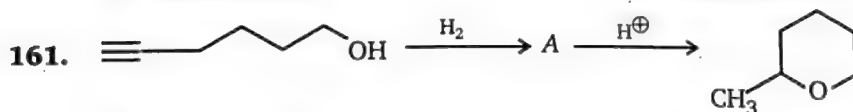
Dehydration of the above compound will give :

- (a) meso product (b) racemic mixture  
(c) diastereomer (d) optically pure enantiomer



What is stereochemistry of product ?

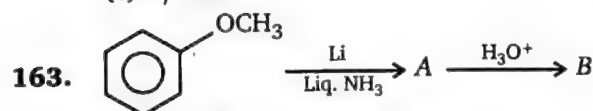
- (a) Racemic mixture (b) Optically inactive  
(c) Diastereomers (d) Meso product



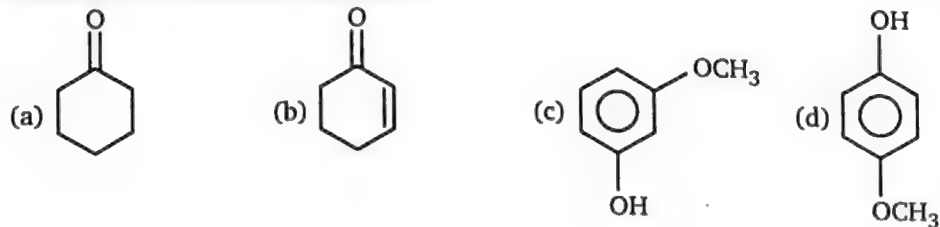
End product formed in the above reaction is :

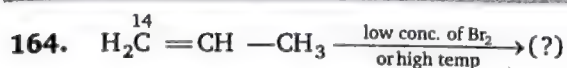
- (a) Optically active (b) Racemic (c) Meso (d) Diastereomer
162. How many moles of  $\text{BH}_3$  are needed to react completely with 2 mole of 1-pentene in hydroboration-oxidation reaction ?

- (a) 2 mole (b) 3 mole  
(c)  $2/3$  mole (d)  $3/2$  mole



Product (B) in the above reaction is :





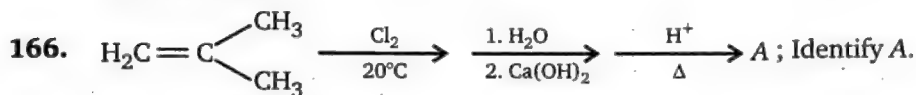
Product of the above reaction is :

- (a)  $\text{H}_2\text{C}=\text{CH}-\text{CH}_2-\text{Br}$  (b)  $\text{H}_2\text{C}=\text{CH}-\text{CH}_2-\text{Br}$   
 (c)  $\begin{array}{c} \text{CH}_2-\text{CH}-\text{CH}_3 \\ | \quad | \\ \text{Br} \quad \text{Br} \end{array}$  (d) both (a) and (b)

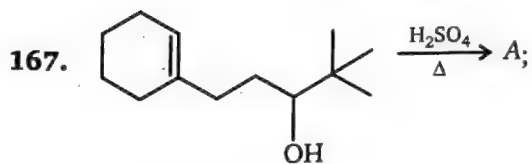
165. In which of the following reactions 1,3-butadiene will be obtained as a major product ?

- (a)  $\text{Br}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{Br} \xrightarrow[(\text{CH}_3)_3\text{COH}]{(\text{CH}_3)_3\text{COK (2mole)}}$   
 (b)  $\text{HO}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{OH} \xrightarrow{\text{Conc. H}_2\text{SO}_4}$   
 (c)  $\text{H}_2\text{C}=\text{CH}-\text{C}\equiv\text{CH} \xrightarrow[\text{Ni}_2\text{B}]{\text{H}_2(1\text{mole})}$

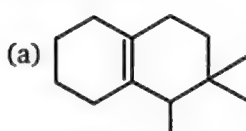
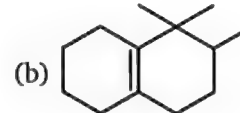
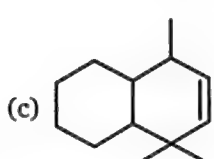
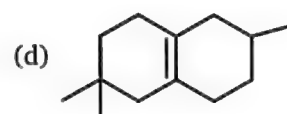
(d) All of these



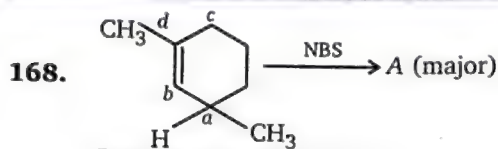
- (a)  $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{C}-\text{CH}_2 \\ | \quad \backslash \\ \text{O} \quad \text{O} \end{array}$  (b)  $\text{CH}_3-\text{CH}-\text{CHO}$   
 (c)  $\text{CH}_3-\text{C}(=\text{O})-\text{CH}_2-\text{CH}_3$  (d)  $\text{CH}_3-\text{C}(\text{CH}_3)=\text{CH}_2$



Product (A) is :

- (a)  (b)   
 (c)  (d) 

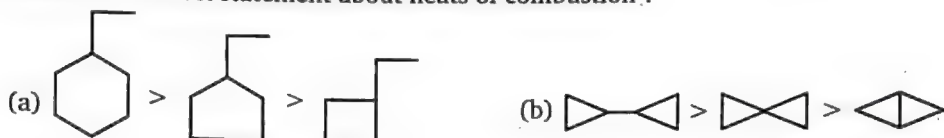




Bromination take place at :

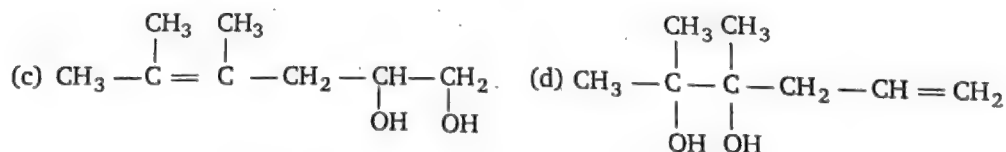
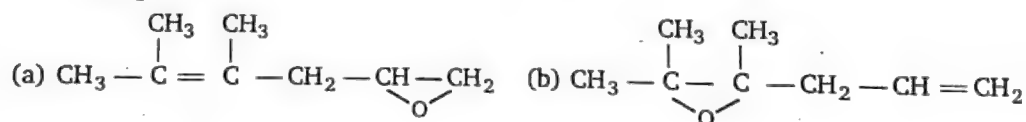
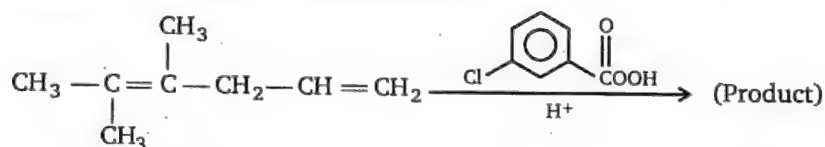
- (a) a (b) b (c) c (d) d

169. Which is incorrect statement about heats of combustion ?

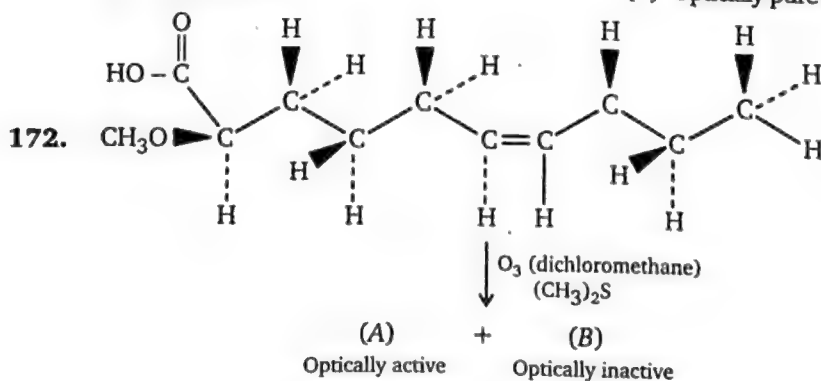


(c) Iso-butene > *trans*-2-butene > 1-butene (d) *n*-Hexane < *n*-Heptane < *n*-Octane

170. Predict the major product of the reaction.

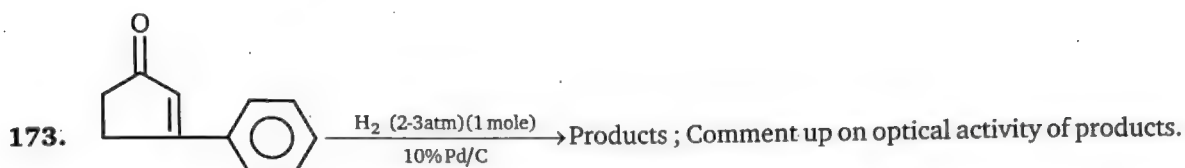


- (a) Meso compound (b) Enantiomeric pair  
(c) Diastereomers (d) Optically pure enantiomer

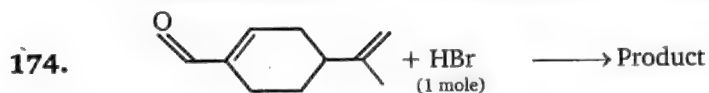


Product (A) of above reaction is:

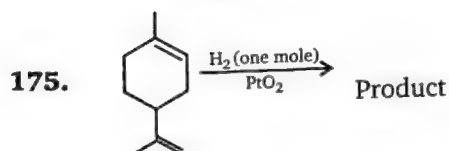
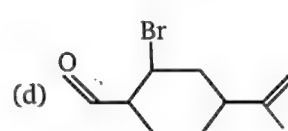
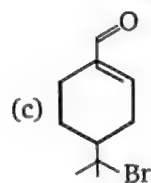
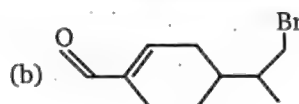
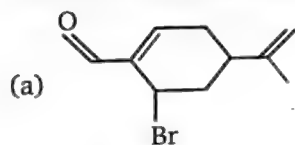
- (a)  $\text{CH}_3\text{O}-\underset{\text{CO}_2\text{H}}{\text{CH}}-\underset{\text{CO}_2\text{H}}{\text{CH}_2}-\text{CH}_2-\text{CHO}$
- (b)  $\text{CH}_3\text{O}-\text{CH}_2-\underset{\text{CO}_2\text{H}}{\text{CH}}-\text{CH}_2-\text{CO}_2\text{H}$
- (c)  $\text{CH}_3\text{O}-\underset{\text{CO}_2\text{H}}{\text{CH}}-\text{CH}_2-\text{CH}_2-\text{CO}_2\text{H}$
- (d)  $\text{CH}_3\text{O}-\underset{\text{CO}_2\text{H}}{\text{CH}}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CHO}$



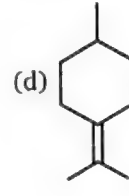
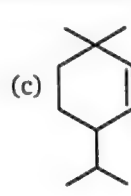
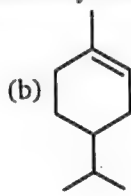
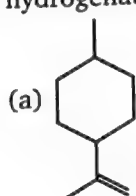
- (a) Diastereomers (b) Racemic mixture (c) Meso (d) Optically pure enantiomer



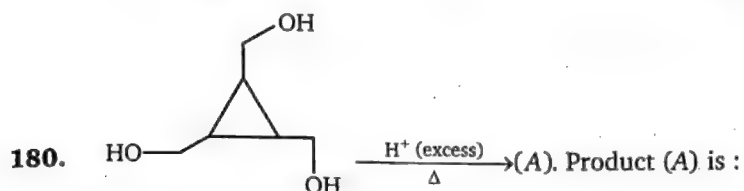
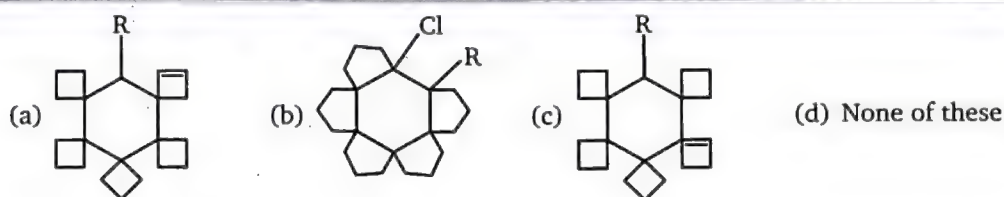
Addition of a mineral acid to an olefin bond leads to major product, Identify it:



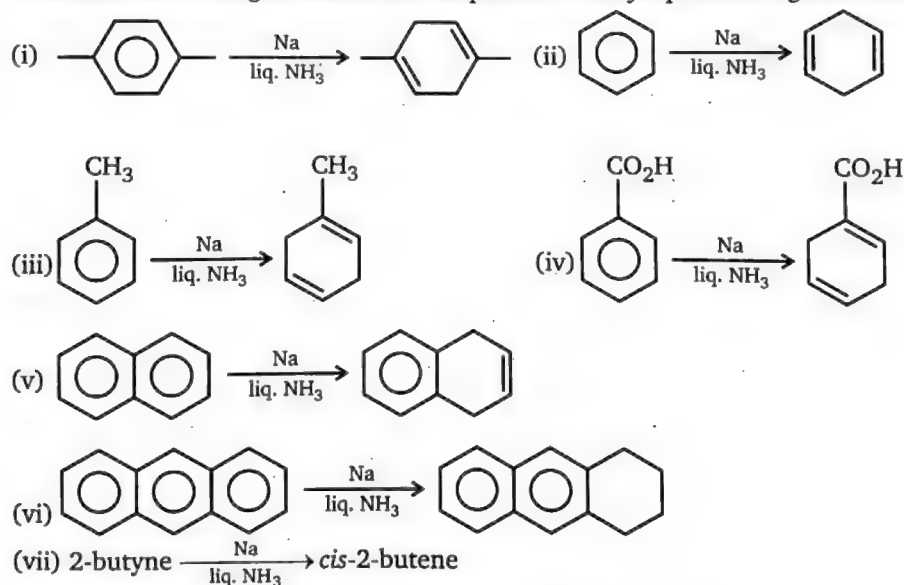
In polyenes that contain differently substituted ( $\text{C}=\text{C}$ ) double bonds, it is possible to hydrogenate chemoselectively one ( $\text{C}=\text{C}$ ) double bond. Product is :





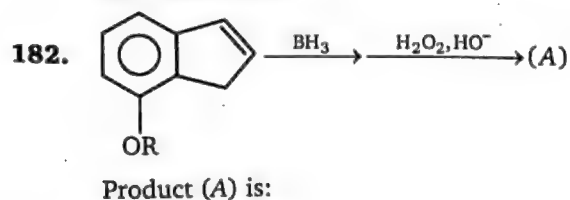


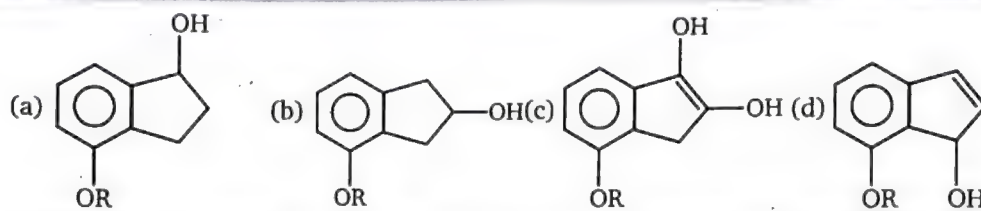
181. Which of the following reactions do not represent the major product of given Birch reductions ?



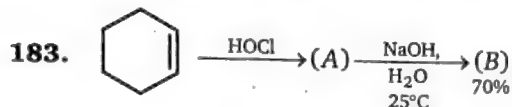
- (a) (i), (iii), (vi)  
 (c) (iv), (v), (vi)

- (b) (iv), (vi), (vii)  
 (d) (i), (ii), (v), (vii)



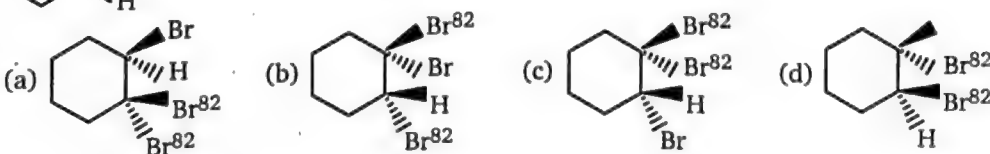
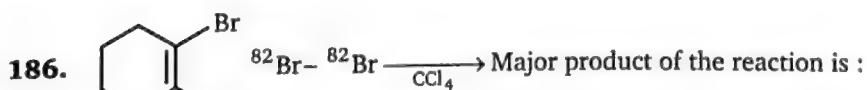
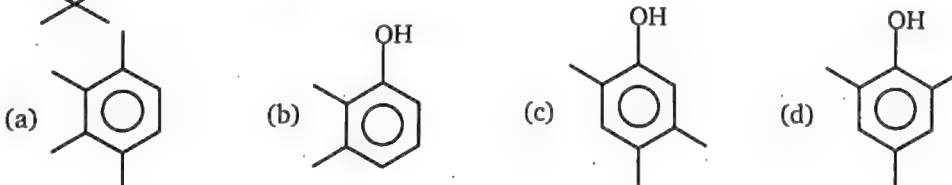
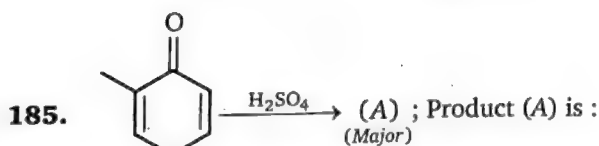
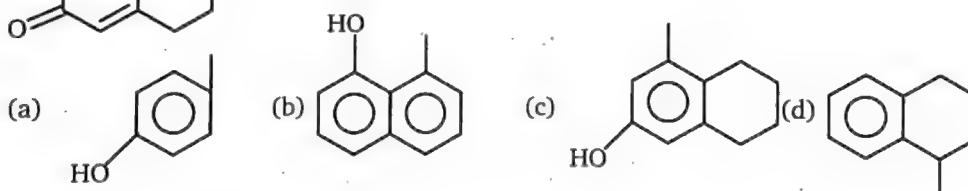
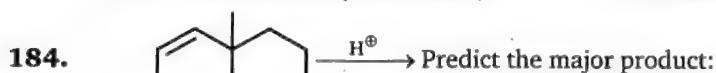


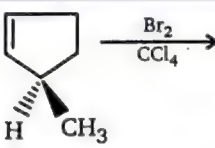
**Hint :** Think carefully about the relative stabilization of developing positive charge, when the double bond reacts with an electrophile.



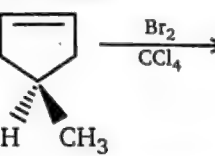
Correct statement about above reaction is:

- (a)  $A = \text{cis-2-chlorocyclohexanol}$ ,  $B = \text{cyclohexeneoxide}$   
 (b)  $A = \text{trans-2-chlorocyclohexanol}$ ,  $B = \text{anti-diol}$   
 (c)  $A = \text{trans-2-chlorocyclohexanol}$ ,  $B = \text{cyclohexeneoxide}$   
 (d)  $A = \text{cis-2-chlorocyclohexanol}$ ,  $B = \text{anti-diol}$

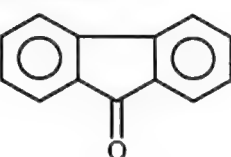


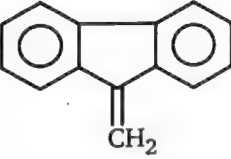
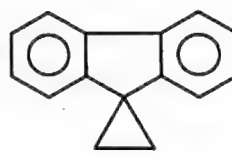
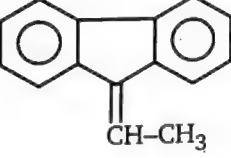
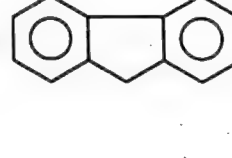
187.  stereochemistry of the product is:

- (a) Diastereomers (b) Racemic mixture  
(c) Meso (d) Pure Enantiomers

188.  Product/s obtained is/are :

- (a) Diastereomers (b) Racemic  
(c) Meso (d) Optically pure enantiomers

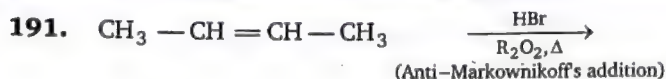
189.   $\xrightarrow{\text{Ph}_3\text{P}=\text{CH}_2} \xrightarrow{\text{Ph}_3\text{P}=\text{CH}_2} (x)$ ; Product (x) is :

- (a)  (b)   
(c)  (d) 

190.  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \underset{\text{CH}_3}{\overset{\text{CH}_3}{\text{C}}} - \text{CH}_2 - \text{OH} \xrightarrow[\Delta]{\text{H}^+} (A)$ ; Product (A) is :  
(major)

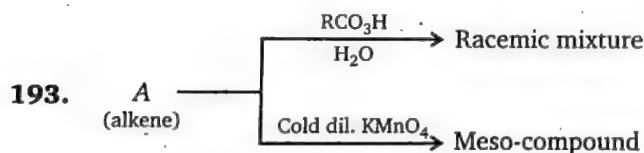
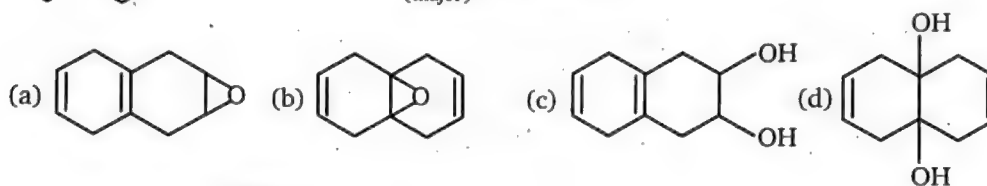
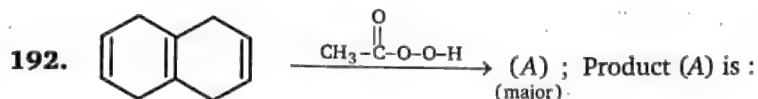
- (a)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \underset{\text{CH}_3}{\text{C}} = \text{CH} - \text{CH}_3$   
(b)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH} = \text{C} \begin{matrix} \text{CH}_3 \\ \text{CH}_3 \end{matrix}$   
(c)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \underset{\text{CH}_3}{\text{C}} = \text{CH}_2$   
(d)  $\text{CH}_3 - \text{CH}_2 - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_2 - \underset{\text{CH}_3}{\text{C}} = \text{CH}_2$





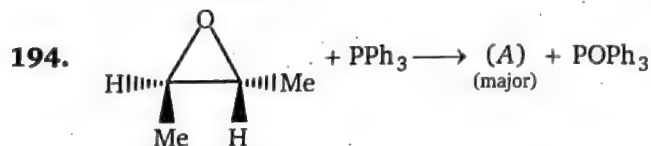
Comment on optical activity of the products:

- (a) Racemic (b) Diastereomer  
(c) Meso (d) Optically pure enantiomer



Alkene (A) will be :

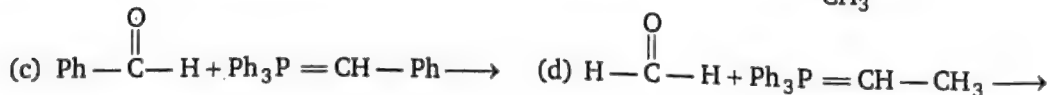
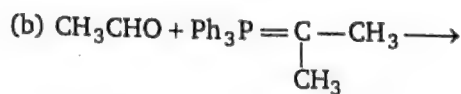
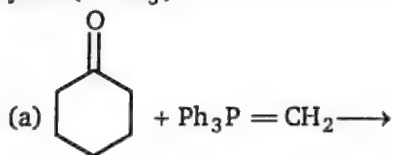
- (a) *cis*-2-pentene (b) *cis*-2-hexene  
(c) *cis*-4-octene (d) *trans*-2-hexene



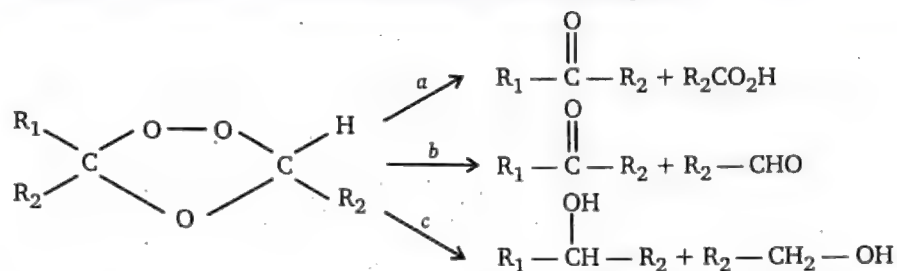
Product (A) is

- (a) *trans*-2-butene (b) *cis*-2-butene (c) 1-butene (d) Iso-butene

195. In which of the following reactions, two products will be formed other than phosphonium ylide ( $\text{POPh}_3$ )

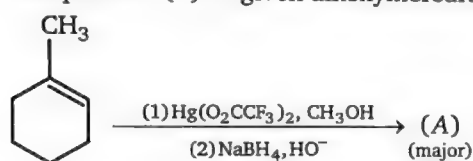


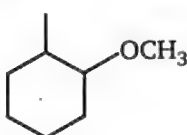
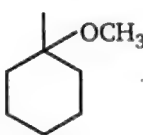
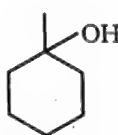
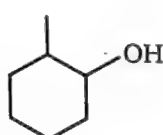
196. To carry out the given conversions, select the correct option:

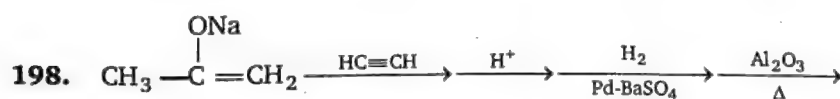


- (a)  $a = \text{Ag}_2\text{O}$ ,  $b = \text{Zn}/\text{CH}_3\text{CO}_2\text{H}$ ,  $c = \text{LiAlH}_4$   
 (b)  $a = \text{H}_2\text{O}_2$ ,  $b = \text{CH}_3 - \text{S} - \text{CH}_3$ ,  $c = \text{NaBH}_4$   
 (c) Both (a) and (b)  
 (d) None of these

197. The product (A) of given alkoxymercuration de-mercuration is :



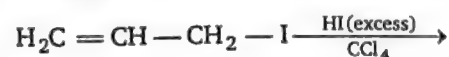
- (a)  (b)  (c)  (d) 



End product of the reaction is :

- (a)  $\text{H}_2\text{C} = \text{CH} - \underset{\text{CH}_3}{\text{C}} = \text{CH}_2$  (b)  $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH} = \text{CH}_2$   
 (c)  $\text{H}_2\text{C} = \text{CH} - \text{CH} = \text{CH}_2$  (d)  $\text{H}_2\text{C} = \text{CH} - \text{CH}_2 - \text{CH} = \text{CH}_2$

199. Major product of the given reaction is :

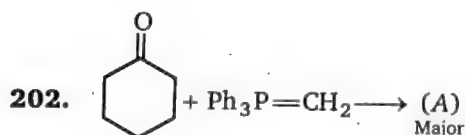
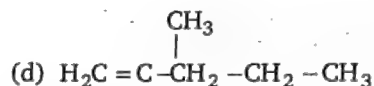
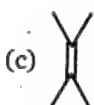
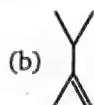
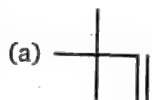


- (a)  $\text{CH}_3 - \underset{\text{I}}{\text{CH}} - \underset{\text{I}}{\text{CH}_2}$  (b)  $\text{CH}_3 - \underset{\text{I}}{\text{CH}} - \text{CH}_3$   
 (c)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{I}$  (d)  $\text{I} - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{I}$

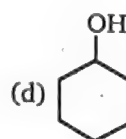
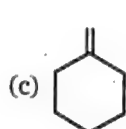
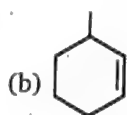
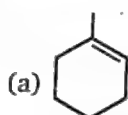
200. The rate constant for a reaction can be increased by a the stability of the reactant or by b the stability of the transition state. Select the correct choice for a and b.

- (a) decreasing, decreasing (b) increasing, decreasing  
(c) decreasing, increasing (d) increasing, increasing

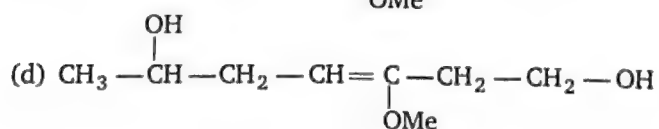
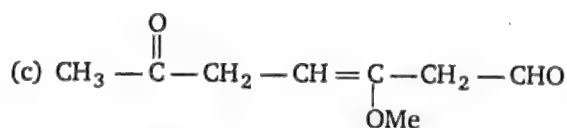
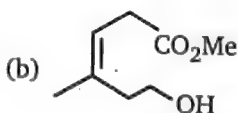
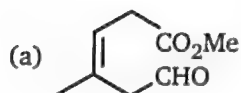
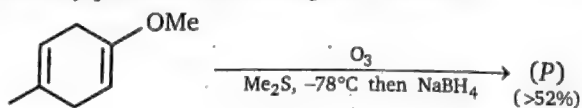
201. Major product of the given reaction is :



Major product (A) is :

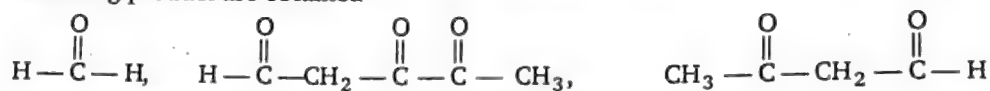


203. In the given reaction, only one alkene undergo preferential oxidation by electrophilic ozone. Identify product (P) of the given reaction:

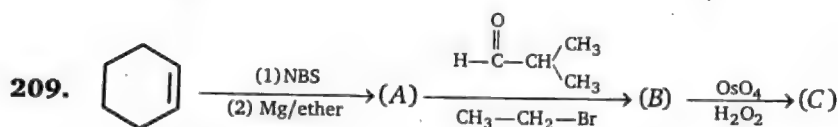
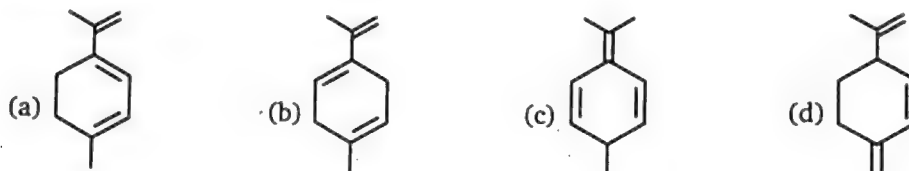




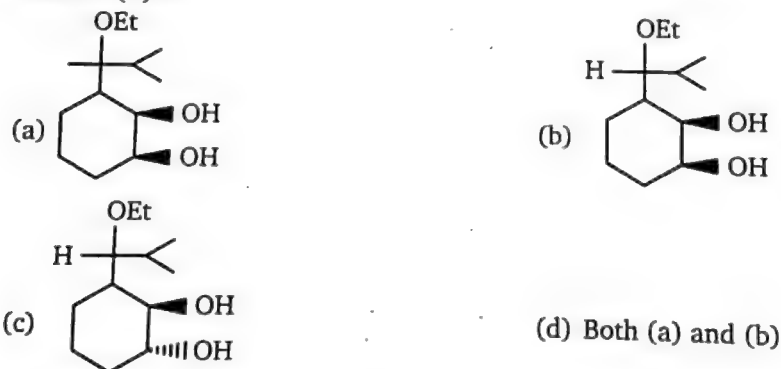
208. An unknown alkene (A) reacts with 3 mole of  $H_2$  gas in presence of platinum catalyst to form 1-isopropyl-4-methyl cyclohexane. When unknown alkene (A) is ozonized and reduced, following product are obtained



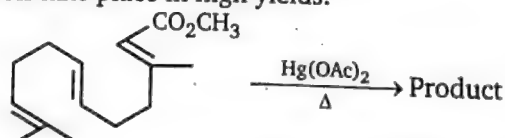
The alkene (A) is :



Product (C) is

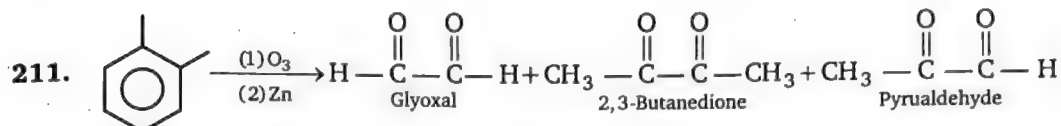
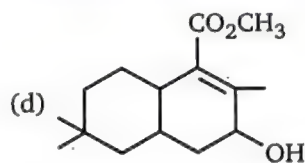
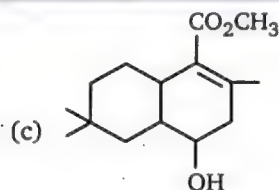


210. The following reaction take place in high yields.



Use your knowledge of alkene chemistry to predict a product even though you have never seen this reaction before





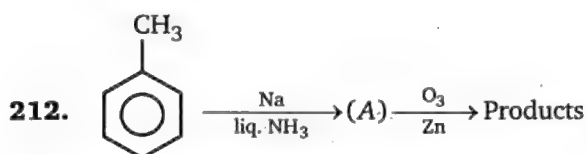
What is the ratio of glyoxal to pyruvaldehyde obtained in the above reaction ?

(a) 1 : 3

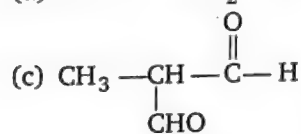
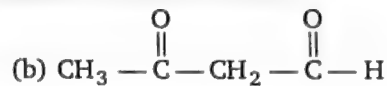
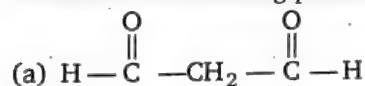
(b) 3 : 1

(c) 3 : 2

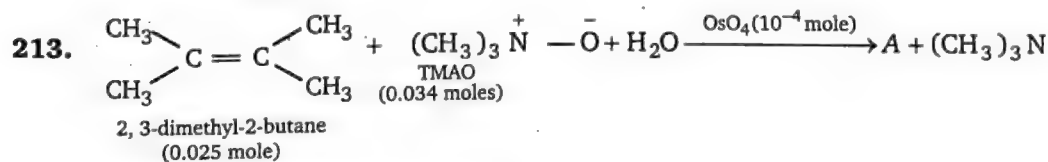
(d) 2 : 3



Which of the following product cannot be obtained in above reaction ?

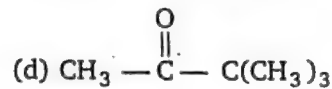
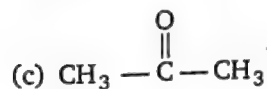
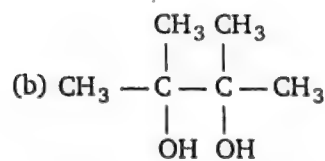
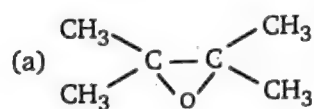


(d) None of these

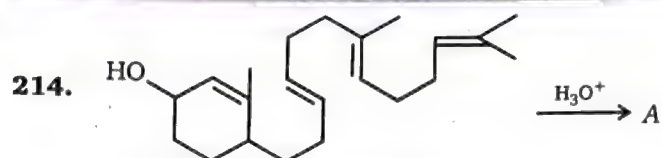


(TMAO → trimethyl amine -N - oxide)

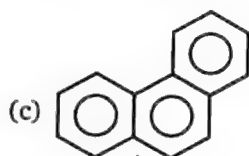
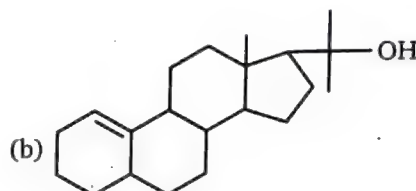
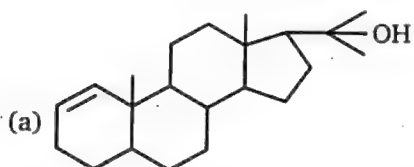
Product (A) is :



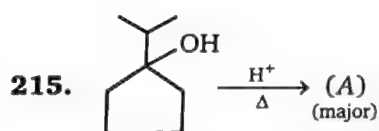




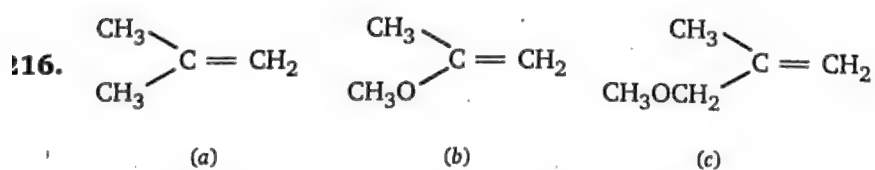
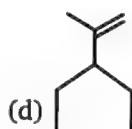
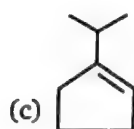
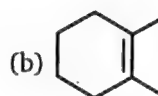
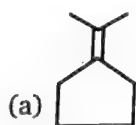
Product (A) of the reaction is :



(d) None of these



Product (A) is :



Arrange the above in the decreasing order of reactivity towards HBr :

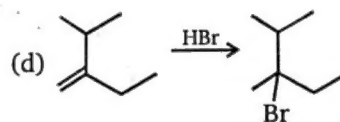
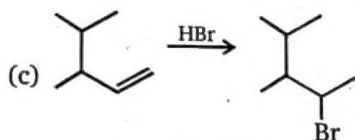
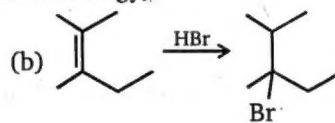
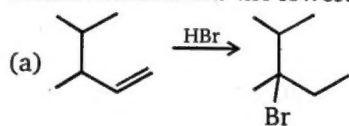
(a)  $a > b > c$

(b)  $b > a > c$

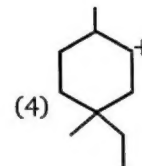
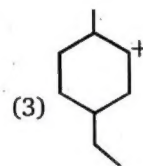
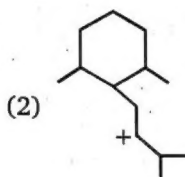
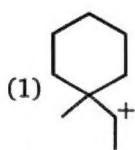
(c)  $b > c > a$

(d)  $a > c > b$

217. Which reaction has the lowest  $\Delta G^\ddagger$  or (Activation-Energy)?



218. Which of the following will rearrange?



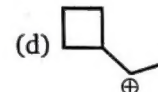
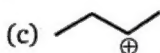
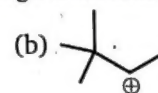
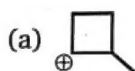
(a) 1

(b) 1 and 3

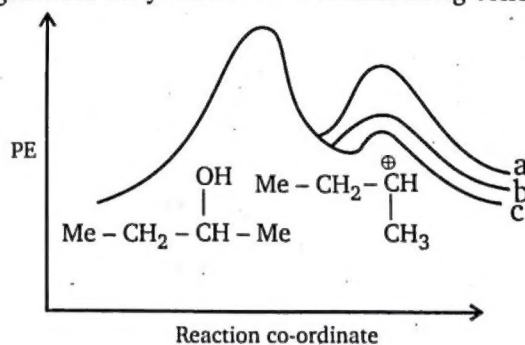
(c) All

(d) 1, 2, 4,

219. Which of the following is most likely to undergo a favorable hydride shift?



220. Energy profile diagram for dehydration of 2-butanol using conc.  $\text{H}_2\text{SO}_4$  is given below :



Product (b) of above reaction is :

(a) 1-butene

(b) *cis*-2-butene

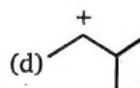
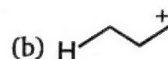
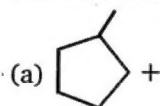
(c) *trans*-2-butene

(d) *iso*-butene

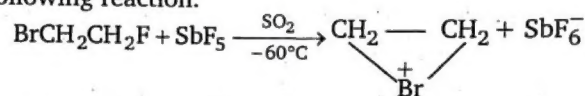
221. How many alkene on catalytic hydrogenation given isopentane as a product ?

- (a) 2 (b) 3  
(c) 4 (d) 5

222. Which of the following would not rearrange to a more stable form ?

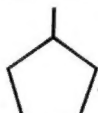


223. Consider the following reaction.

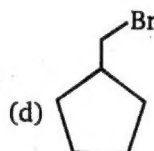
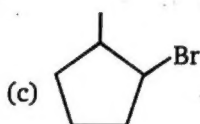
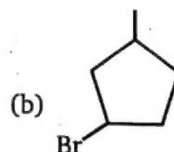
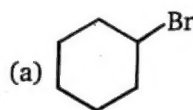


In this reaction  $\text{SbF}_5$  acts as:

- (a) an acid (b) a base  
(c) a nucleophile (d) an electrophile

224.   $\xrightarrow{\text{Br}_2/h\nu}$  Major (X)  $\xrightarrow[\text{KOH}/\Delta]{\text{Alcoholic}}$  Major (Y)  $\xrightarrow[\text{Peroxide}]{\text{H-Br}}$  Major (Z):

Product (Z) is:

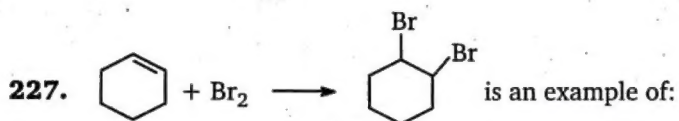
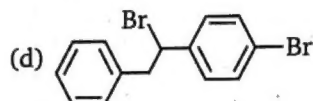
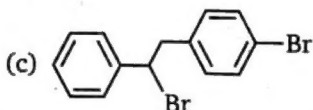
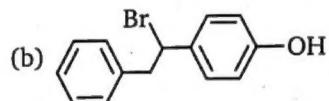
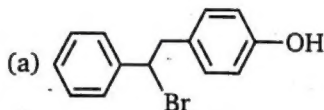
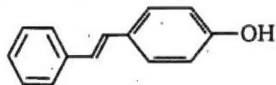


225.  $\text{CH}_3-\text{C}\equiv\text{C}-\text{H} \xrightarrow{\text{NaNH}_2} \xrightarrow{\text{CH}_3-\text{I}} (\text{A}) \xrightarrow[\text{Pd-CaCO}_3]{\text{H}_2} (\text{C})$   
 $\xrightarrow{\text{Li/liq NH}_3} (\text{B})$

Relation between (B) and (C) is:

- (a) Enantiomer (b) Diastereomer  
(c) Geometrical isomer (d) Meso

226. The reaction of HBr with the following compound would produce :

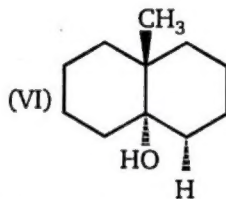
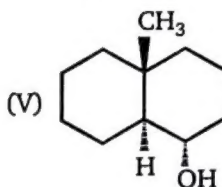
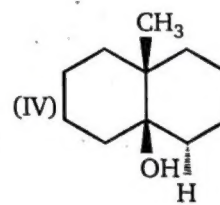
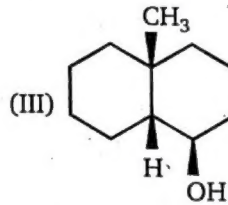
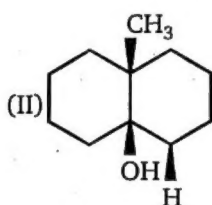
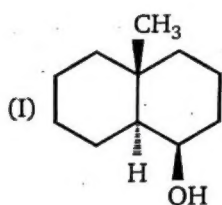
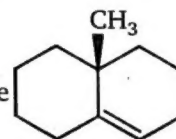


- (a) Nucleophilic addition (b) Nucleophilic substitution  
(c) Electrophilic addition (d) Electrophilic substitution  
(e) Free radical substitution

228. Olefins can be hydrogenated by :

- (a) Zinc and HCl (b) Nascent hydrogen  
(c) Raney Ni and H (d) Lithium hydride in ether

229. What are the products obtained on hydroboration-oxidation of the given alkene



(a) I and III

(b) II and IV

(c) II and VI

(d) III and V



ANSWERS — LEVEL 1															
1.	(c)	2.	(d)	3.	(c)	4.	(d)	5.	(b)	6.	(b)	7.	(c)	8.	(c)
9.	(c)	10.	(d)	11.	(b)	12.	(d)	13.	(c)	14.	(b)	15.	(b)	16.	(c)
17.	(d)	18.	(d)	19.	(b)	20.	(d)	21.	(b)	22.	(a)	23.	(b)	24.	(b)
25.	(b)	26.	(b)	27.	(d)	28.	(b)	29.	(d)	30.	(b)	31.	(c)	32.	(b)
33.	(a)	34.	(b)	35.	(b)	36.	(b)	37.	(b)	38.	(b)	39.	(b)	40.	(b)
41.	(d)	42.	(e)	43.	(c)	44.	(c)	45.	(a)	46.	(c)	47.	(c)	48.	(b)
49.	(b)	50.	(b)	51.	(b)	52.	(a)	53.	(b)	54.	(d)	55.	(b)	56.	(c)
57.	(c)	58.	(b)	59.	(c)	60.	(a)	61.	(b)	62.	(d)	63.	(a)	64.	(b)
65.	(d)	66.	(b)	67.	(d)	68.	(a)	69.	(c)	70.	(d)	71.	(d)	72.	(c)
73.	(d)	74.	(c)	75.	(a)	76.	(c)	77.	(d)	78.	(b)	79.	(d)	80.	(d)
81.	(c)	82.	(b)	83.	(a)	84.	(a)	85.	(a)	86.	(d)	87.	(b)	88.	(b)
89.	(c)	90.	(d)	91.	(b)	92.	(b)	93.	(a)	94.	(a)	95.	(a)	96.	(d)
97.	(b)	98.	(a)	99.	(c)	100.	(d)	101.	(b)	102.	(b)	103.	(d)	104.	(b)
105.	(b)	106.	(c)	107.	(b)	108.	(b)	109.	(d)	110.	(d)	111.	(c)	112.	(b)
113.	(a)	114.	(b)	115.	(c)	116.	(a)	117.	(b)	118.	(b)	119.	(b)	120.	(d)
121.	(b)	122.	(c)	123.	(a)	124.	(b)	125.	(d)	126.	(a)	127.	(b)	128.	(c)
129.	(d)	130.	(a)	131.	(c)	132.	(d)	133.	(c)	134.	(a)	135.	(d)	136.	(c)
137.	(b)	138.	(d)	139.	(d)	140.	(b)	141.	(b)	142.	(b)	143.	(b)	144.	(b)
145.	(b)	146.	(c)	147.	(b)	148.	(a)	149.	(d)	150.	(b)	151.	(a)	152.	(d)
153.	(c)	154.	(c)	155.	(b)	156.	(c)	157.	(a)	158.	(a)	159.	(b)	160.	(c)
161.	(b)	162.	(c)	163.	(b)	164.	(d)	165.	(d)	166.	(b)	167.	(b)	168.	(a)
169.	(c)	170.	(b)	171.	(b)	172.	(d)	173.	(b)	174.	(c)	175.	(b)	176.	(b)
177.	(b)	178.	(c)	179.	(b)	180.	(c)	181.	(b)	182.	(b)	183.	(c)	184.	(c)
185.	(c)	186.	(b)	187.	(a)	188.	(b)	189.	(b)	190.	(b)	191.	(a)	192.	(b)
193.	(c)	194.	(b)	195.	(c)	196.	(c)	197.	(b)	198.	(a)	199.	(b)	200.	(c)
201.	(c)	202.	(c)	203.	(b)	204.	(d)	205.	(b)	206.	(c)	207.	(b)	208.	(b)
209.	(b)	210.	(b)	211.	(c)	212.	(c)	213.	(b)	214.	(a)	215.	(b)	216.	(b)
217.	(d)	218.	(c)	219.	(a)	220.	(b)	221.	(b)	222.	(c)	223.	(d)	224.	(c)
225.	(b,c)	226.	(b)	227.	(c)	228.	(c)	229.	(d)						